

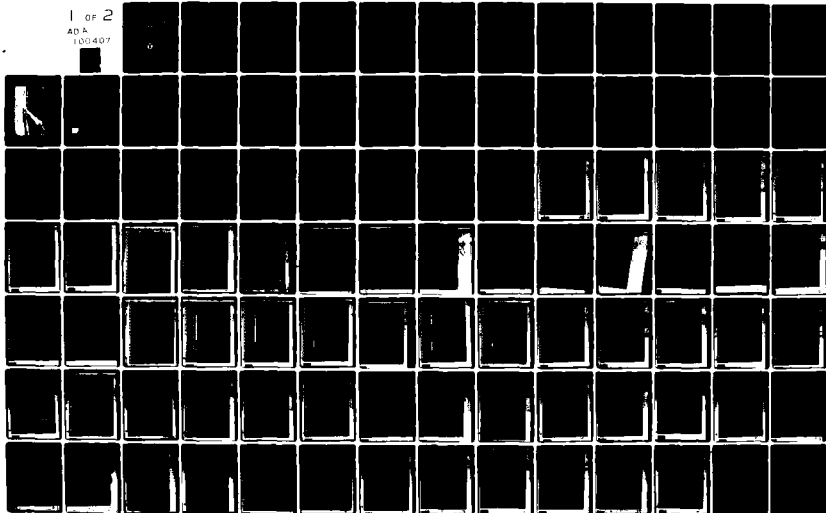
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NATIONAL DAM SAFETY PROGRAM. LAKE ROBERT ROOKE DAM (NJ00262), D--ETC(U)
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DELAWARE RIVER BASIN
BRANCH OF BIG FLAT BROOK
SUSSEX COUNTY
NEW JERSEY.

LEVEL II

LAKE ROBERT ROOKE DAM

(NJ 00262) S

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PHASE I INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM



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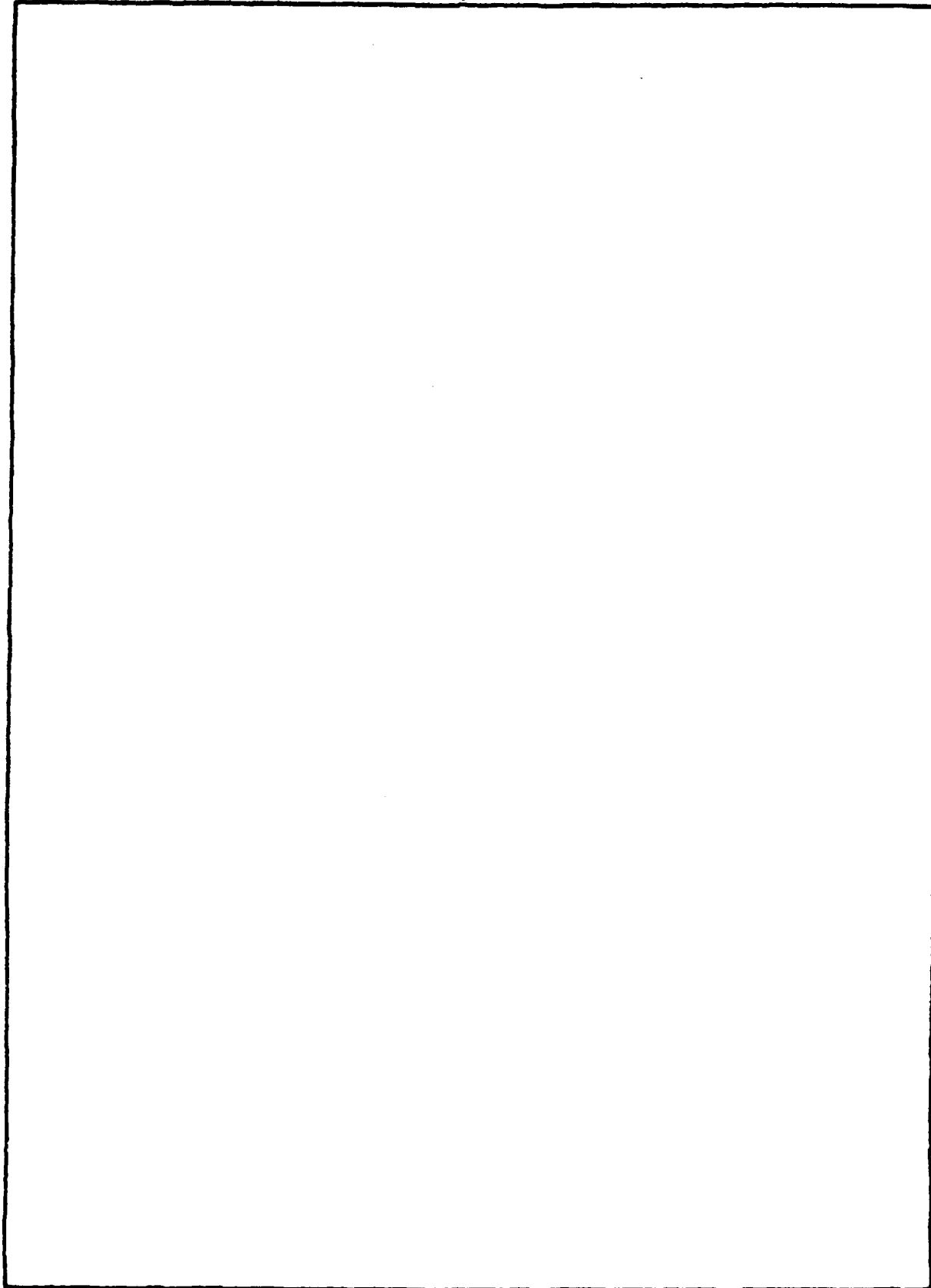
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.		

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NAPEN-N

11 JUN 1981

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

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Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Lake Robert Rooke Dam in Sussex County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Lake Robert Rooke Dam, a high hazard potential structure, is judged to be in fair overall condition. The dam's spillways are considered inadequate because a flow equivalent to 52 percent of the Probable Maximum Flood would cause the dam to be overtopped. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillways' adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Within three months of the consultant's findings, remedial measures to ensure spillway adequacy should be initiated.

b. The following remedial actions should be initiated within three months from the date of approval of this report:

(1) Determine the operating condition of the low level outlet slide gate and repair if necessary.

(2) Remove the cobble dam and other obstructions from the drop inlet discharge channel.

(3) Remove all branches and debris from the weirs and riser of the drop inlet spillway and provide trash racks.

(4) Repair all eroded areas on the dam embankment.

NAPEN-N

Honorable Brendan T. Byrne

c. The following remedial actions should be initiated within six months from the date of approval of this report:

(1) Perform additional investigation to determine seepage conditions through and under the dam, the engineering properties of the dam and foundation, and determine whether or not conventional safety margins exist under more severe stress conditions than those observed during the inspection, and what modifications may be required to achieve such safety margins.

(2) Properly remove all trees from the embankment and provide adequate filter coverage on the downstream face to prevent any piping which may occur as a result of future root decay.

d. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam within one year from the date of approval of this report.

e. An emergency action plan and warning system should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency at the dam within three months from the date of approval of this report.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

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Honorable Brendan T. Byrne

An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,



JAMES G. TON
Colonel, Corps of Engineers
Commander and District Engineer

1 Incl
As stated

Copies furnished:

Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

LAKE ROBERT ROOKE DAM (NJ00267)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 26 September and 11 December 1980 by Langan Engineering Associates, Inc. under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-567.

Lake Robert Rooke Dam, a high hazard potential structure, is judged to be in fair overall condition. The dam's spillways are considered inadequate because a flow equivalent to 52 percent of the Probable Maximum Flood would cause the dam to be overtopped. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillways' adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Within three months of the consultant's findings, remedial measures to ensure spillway adequacy should be initiated.

b. The following remedial actions should be initiated within three months from the date of approval of this report:

(1) Determine the operating condition of the low level outlet slide gate and repair if necessary.

(2) Remove the cobble dam and other obstructions from the drop inlet discharge channel.

(3) Remove all branches and debris from the weir and riser of the drop inlet spillway and provide trash racks.

(4) Repair all eroded areas on the dam embankment.

c. The following remedial actions should be initiated within six months from the date of approval of this report:

(1) Perform additional investigation to determine seepage conditions through and under the dam, the engineering properties of the dam and foundation, and determine whether or not conventional safety margins exist under more severe stress conditions than those observed during the inspection, and what modifications may be required to achieve such safety margins.

(2) Properly remove all trees from the embankment and provide adequate filter coverage on the downstream face to prevent any piping which may occur as a result of future root decay.

d. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam within one year from the date of approval of this report.

d. An emergency action plan and warning system should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency at the dam within three months from the date of approval of this report.

APPROVED: _____

James G. Ton
JAMES G. TON

Colonel, Corps of Engineers
Commander and District Engineer

DATE: _____

4 Dec 1981

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

NAME OF DAM:	LAKE ROBERT ROOKE DAM
ID NUMBER:	FED ID No NJ 00262
STATE LOCATED:	NEW JERSEY
COUNTY LOCATED:	SUSSEX
STREAM:	BRANCH OF BIG FLAT BROOK
RIVER BASIN:	DELAWARE
DATE OF INSPECTION:	SEPTEMBER 1980

ASSESSMENT OF GENERAL CONDITIONS

Lake Robert Rooke dam, classified as having high hazard potential, is in fair overall condition. Localized spongy ground exists at the downstream toe. Minor erosion has occurred in a number of places on the dam embankment. No riprap was observed on the upstream embankment or in drop inlet spillway discharge channel. The embankments and emergency spillway are becoming overgrown with brush and trees. Many branches have become lodged in the weirs and riser of the drop inlet spillway. The slide gate of the low level outlet located in the spillway riser is leaking and its operating condition is unknown. The dam appeared stable during our inspection, however, the available information is inadequate to determine the degree of stability of the dam and its future performance under more severe stress conditions than those observed during our inspection.

The combined drop inlet and emergency spillway capacity as determined by the Corps of Engineers Screening criteria is inadequate. We estimate the dam can adequately pass only 51% of the PMF.

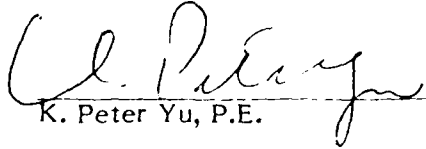
The following are recommended to be done soon:

Determine the operating condition of the low level outlet slide gate and repair if necessary. Remove the cobble dam and other obstructions from the drop inlet discharge channel. Remove all branches and debris from the weirs and riser of the drop inlet spillway and provide trash racks. Repair all eroded areas on the dam embankments.

The following measures are recommended to be taken in the near future:

Develop written operational procedures and periodic maintenance plan to ensure the safety of the dam. Perform additional investigation to determine seepage conditions through and under the dam, the engineering properties of the

dam and foundation, and determine whether or not conventional safety margins exist under more severe stress conditions than those observed during our inspection, and what modifications may be required to achieve such safety margins. Properly remove all trees from the embankment and provide adequate filter coverage on the downstream face to prevent any piping which may occur as a result of future root decay.


K. Peter Yu, P.E.

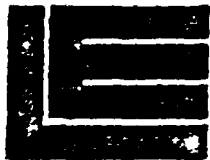


OVERALL VIEW
LAKE ROBERT POWER DAM

26 September 1966

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

NAME OF DAM:	LAKE ROBERT ROOKE DAM
ID NUMBER:	FED ID No NJ 00262
STATE LOCATED:	NEW JERSEY
COUNTY LOCATED:	SUSSEX
STREAM:	BRANCH OF BIG FLAT BROOK
RIVER BASIN:	DELAWARE
DATE OF INSPECTION:	SEPTEMBER 1980



LANGAN ENGINEERING ASSOCIATES, INC.

Consulting Civil Engineers
990 CLIFTON AVENUE
CLIFTON, NEW JERSEY
201-472-9366

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NATIONAL DAM SAFETY REPORT

LAKE ROBERT ROOKE DAM FED ID NO NJ 00262

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PREFACE

This report is prepared under guidance contained in the *Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations*. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

SECTION 1 PROJECT INFORMATION

1.1 General

Authority to perform the Phase I Safety Inspection of Lake Robert Rooke Dam was received from the State of New Jersey, Department of Environmental Protection, Division of Water Resources by letter dated 12 August 1980. This Authority was given pursuant to the National Dam Inspection Act, Public Law 92-367 and by agreement between the State and the US Army Engineers District, Philadelphia.

The purpose of the Phase I Investigation is to develop an assessment of the general conditions with respect to safety of Lake Robert Rooke Dam and appurtenances based upon available data and visual inspection, and determine any need for emergency measures and conclude if additional studies, investigations and analyses are necessary and warranted. The assessment is made using screening criteria established in Recommended Guidelines for Safety Inspection of Dams prepared by the Department of Army, Office of the Chief of Engineers. It is not the purpose of the inspection report to imply that a dam meeting or failing to meet the screening criteria is, per se, certainly adequate or inadequate.

1.2 Project Description

a. Description of Dam and Appurtenances

Lake Robert Rooke Dam is a 620 foot long, 20 foot high earthfill dam constructed in 1963 through 1964. The dam has a top width of approximately 14 feet with side slopes of 2H:1V downstream and 2 1/2 H:1V upstream. It has a reinforced concrete drop inlet spillway with a 16 inch diameter CIP valved low level outlet discharging into the spillway riser. The spillway discharges through a 54 inch diameter CMP. There is an earth cut emergency spillway located beyond the right abutment of the dam.

b. Location

The dam is located at the southwest end of Lake Robert Rooke off Flat Brook Road in Sandyston Township, Sussex County, New Jersey. It is located at north latitude 41°12.7' and west longitude 74°47.9'. A regional vicinity map is given in Fig. 1.

c. Size Classification

Lake Robert Rooke Dam is classified as "small" based on its maximum height of 20 feet which is less than 40 feet. It is classified as "small" based on its maximum storage capacity of 147 ac ft which is more than 50 ac ft but less than 1000 ac ft. Accordingly, the dam is classified as "small" in size.

d. Hazard Classification

In the National Inventory of Dams, Lake Robert Rooke Dam has been classified as having "High Hazard Potential" on the basis that failure of the dam would cause excessive damage to residences downstream and could potentially cause more than a few deaths. As the dam is centrally located in a YM-YWCA camp ground area which is highly utilized and a major highway (Rt 206) is less than 1/2 mile downstream, it is recommended to keep the Hazard Classification Potential as "High".

e. Ownership

Ownership of the Dam is by the Young Mens and Young Womens Christian Association of Newark and Vicinity, 600 Broad Street, Newark, New Jersey.

f. Purpose of Dam

The purpose of the dam is recreation.

g. Design and Construction History

The dam was designed jointly by the US Department of Agriculture, Soil Conservation Service, and the firm of Woodward-Clyde-Sherard and Associates in 1963. Construction of the dam was begun in 1963 and completed in June of 1964.

h. Normal Operational Procedures

No information has been found concerning operational procedures for the dam.

1.3 Pertinent Data

- | | | |
|----|---|-------------------------------|
| a. | <u>Drainage Area</u> | 1.05 sq. mi. |
| b. | <u>Discharge at Damsite</u> | |
| | Maximum known flood at damsite | unknown |
| | Ungated spillway capacity at max. pool elevation
(Includes drop inlet & emergency spillway) | 2093 cfs (Assumes top of dam) |
| | Total spillway capacity at maximum pool elevation
(Includes drop inlet & emergency spillway) | 2093 cfs (Assumes top of dam) |
| c. | <u>Elevation</u> (Arbitrary datum, taken from available drawings) | |
| | Top Dam | 115.9 |
| | Emergency Spillway Crest | 112.7 |

	Spillway Crest	110.0
	Recreation pool	110.0
	Streambed at centerline of dam	Approx 95.5
	Maximum tailwater	unknown
d.	<u>Reservoir</u>	
	Length of maximum pool	Approx 1300 ft
	Length of recreation pool	Approx 950 ft
e.	<u>Storage (acre-feet)</u>	
	Recreation pool	69 ac-ft
	Top of dam	147.0 ac-ft
f.	<u>Reservoir Surface (acres)</u>	
	Top dam	16.2 ac
	Recreation pool	10.8 ac
g.	<u>Dam</u>	
	Type	Earthfill
	Length	620 ft
	Height	20 ft
	Top Width	14 ft
	Side Slopes	U/S 2 1/2H:1V D/S 2H:1V
	Zoning	None indicated on plans
	Impervious Core	Low permeability soil indicated on plans
	Cutoff	No
	Grout curtain	No

h. Principal Spillway

Type	Reinforced concrete drop inlet
Length of weir	NA
Crest elevation	110.0 (Arbitrary datum)
Gates	None
U/S Channel	NA
D/S Channel	54 in dia. CMP

i. Emergency Spillway

Type	Trapezoidal open channel
Crest elevation	112.7
Width	120 ft
Weir crest length	20 ft
Location	Approx 100 ft west of right dam abutment
U/S Channel	Earth, slopes 0.0205 ft/ft up
D/S Channel	Earth, slopes 0.0400 to 0.0312 ft/ft down

j. Regulating Outlets

16 in dia valved CIP low level outlet discharging into spillway riser

SECTION 2 ENGINEERING DATA

2.1 Design

Lake Robert Rooke Dam was designed jointly by the US Department of Agriculture, Soil Conservation Service and the firm of Woodward-Clyde-Sherard and Associates.

Included in Appendix 1 are:

- a. Preliminary Report entitled Soil and Foundation Investigation and Design, Newark YMCA Dam, Sandyston Township, New Jersey dated 18 June 1963 by Woodward-Clyde-Sherard Associates.

- b. Design Report N. J. - 625-R entitled Earthfill Dam on Branch of Big Flat Brook, Linwood, Newark YM-YWCA Family and Senior Citizens Camp, Sandyston Township, Sussex Co., New Jersey, dated 16 August 1963 by the US Department of Agriculture, Soil Conservation Service.
- c. A set of pertinent design calculations.

2.2 Construction

There is little information available pertaining to the actual construction of the dam. Based on a letter of 11 January 1967 from Mr. Joseph H. Partenheimer, Vice President of the YM-YWCA of Newark and Vicinity to Mr. George R. Shanklin, Chief Engineer and Director, N.J. Division of Water Policy and Supply, there was a licensed engineer in residence during the construction of the dam. Other available information indicates the dam was constructed in accordance with the approved plans and specifications. Included in Appendix 1 are:

- a. Report on Dam Inspection, Newark YMCA Dam, Dam Application No. 564, 2 Oct 1963, by Mr. John H. O'Dowd, Supervisory Engineer, NJ Division of Water Policy and Supply,
- b. Final Report, Construction Inspection, Newark YMCA Dam, Sandyston Township, New Jersey, 14 July 1964 by Woodward-Clyde-Sherard and Associates, and,
- c. Letter, 11 January 1967 from Mr. Joseph H. Partenheimer, Vice President, YM-YWCA of Newark and Vicinity to Mr. George B. Shanklin, Chief Engineer and Director, N.J. Division of Water Policy and Supply.

2.3 Operation

No information is available concerning the operation of Lake Robert Rooke Dam.

2.4 Evaluation

Information concerning the design of the dam is available, however, data pertaining to the engineering properties of the dam and foundation materials is inadequate. The existing available information appears to be valid.

SECTION 3 VISUAL INSPECTION

Lake Robert Rooke Dam appeared to be in fair overall condition at the time of our visual inspection. Minor erosion has occurred in numerous places on the dam embankments. Much of this erosion is due to footpaths along the embankments. The upstream embankment is eroded at the normal pool level. No riprap was observed on the upstream embankment. Localized spongy ground exists at the downstream toe near the centerline of the dam. The embankments are becoming overgrown with brush and small diameter trees.

The drop inlet spillway weirs and riser are accumulating many branches. The slide gate on the 16 inch diameter low level outlet is leaking. The operating condition of the low level outlet is unknown.

The emergency spillway beyond the right abutment of the dam is moderately vegetated with trees and brush.

The reservoir area is surrounded by gently sloping forested land.

The downstream channel beyond the 54 inch CMP drop inlet spillway outlet is a gently sloping streambed surrounded by thick brush and trees. A small cobble dam approximately 1 foot high has been built across the streambed about 30 feet below the spillway discharge pipe. No riprap was observed in the discharge channel.

SECTION 4 OPERATIONAL PROCEDURES

No information concerning operational procedures for the dam have been found. There appears to have been no recent maintenance of the dam. No warning system appears to be in effect.

SECTION 5 HYDRAULICS/HYDROLOGIC

Based on available information, Lake Robert Rooke Dam was designed in 1963 to adequately pass a Six-hour Point Rainfall determined from the U. S. Weather Bureau Technical Paper No. 40 and a Six-hour Point Rainfall Map developed by the U. S. Soil Conservation Service based on records of maximum rainfalls. This storm is equivalent to 10.2 inches of rainfall and has a peak inflow of 2460 cfs. Some design data and calculations are included in Appendix 1.

Conversations with personnel at the YW-YMCA camp report that the dam has not been overtopped to their knowledge.

The hydraulic/hydrologic evaluation is based on a Spillway Design Flood (SDF) equal to the Probable Maximum Flood chosen in accordance with the evaluation guidelines for dams classified as high hazard and small in size. The PMF has been determined by developing a synthetic hydrograph based on the probable maximum precipitation of 22.0 inches (200 sq. mi. - 24 hour). The Corps of Engineers has recommended the use of the SCS triangular unit hydrograph with the curvilinear transformation. Hydrologic computations are presented in Appendix 4. The PMF peak inflow determined for the subject watershed is 4236 cfs.

The combined capacity of the drop inlet and emergency spillway at maximum pool elevation 115.9 is 2093 cfs which is significantly less than the SDF. Flood routing for the PMF indicates the dam will overtop by 0.82 ft. Routing for the 1/2 PMF indicates the dam will not overtop. We estimate the dam can adequately pass only 51% of the PMF.

The present drawdown structure consists of a 16 inch CIP with a slide gate discharging into the spillway riser. Its present operating condition is unknown. Drawdown of the reservoir has been evaluated assuming that the drawdown structure is operable. Our calculations indicate that the lake level could be lowered 3 ft in about 1 day and 12 ft in about 3 days.

SECTION 6 STRUCTURAL STABILITY

Based upon visual observations, the dam appeared stable under conditions existing at the time of our inspection. Slope stability analysis done by the Soil Conservation Service reported a factor of safety of 2.93. However, the analysis was based on estimated values of the engineering properties of foundation and dam materials and represented only one trial failure arc on the upstream face of the dam. Therefore, the stability of the dam may appear to be within conventional safety margins, yet there is insufficient data concerning the engineering properties of dam and foundation materials to determine the degree of stability of the dam.

No operational records have been found. No post construction changes were observed at the time our inspection.

Lake Robert Rooke dam is located in Seismic Zone I of the Seismic Zone Map of Contiguous States. As incomplete analytical evaluation of the static stability of the dam is available, its seismic stability cannot be adequately evaluated without additional investigation.

SECTION 7 ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment

Lake Robert Rooke dam is in fair overall condition. Localized spongy ground exists at the downstream toe. Minor erosion has occurred in a number of places on the dam embankment. No riprap was observed on the upstream embankment or in drop inlet spillway discharge channel. The embankments and emergency spillway are becoming overgrown with brush and trees. Many branches have become lodged in the weirs and riser of the drop inlet spillway. The slide gate of the low level outlet located in the spillway riser is leaking and its operating condition is unknown. The dam appeared stable during our inspection, however, the available information is inadequate to determine the degree of stability of the dam and its future performance under more severe stress conditions than those observed during our inspection.

The combined drop inlet and emergency spillway capacity as determined by the Corps of Engineers Screening criteria is inadequate. We estimate the dam can adequately pass only 51% of the PMF.

7.2 Recommendations/Remedial Measures

The following measures are recommended to be taken soon:

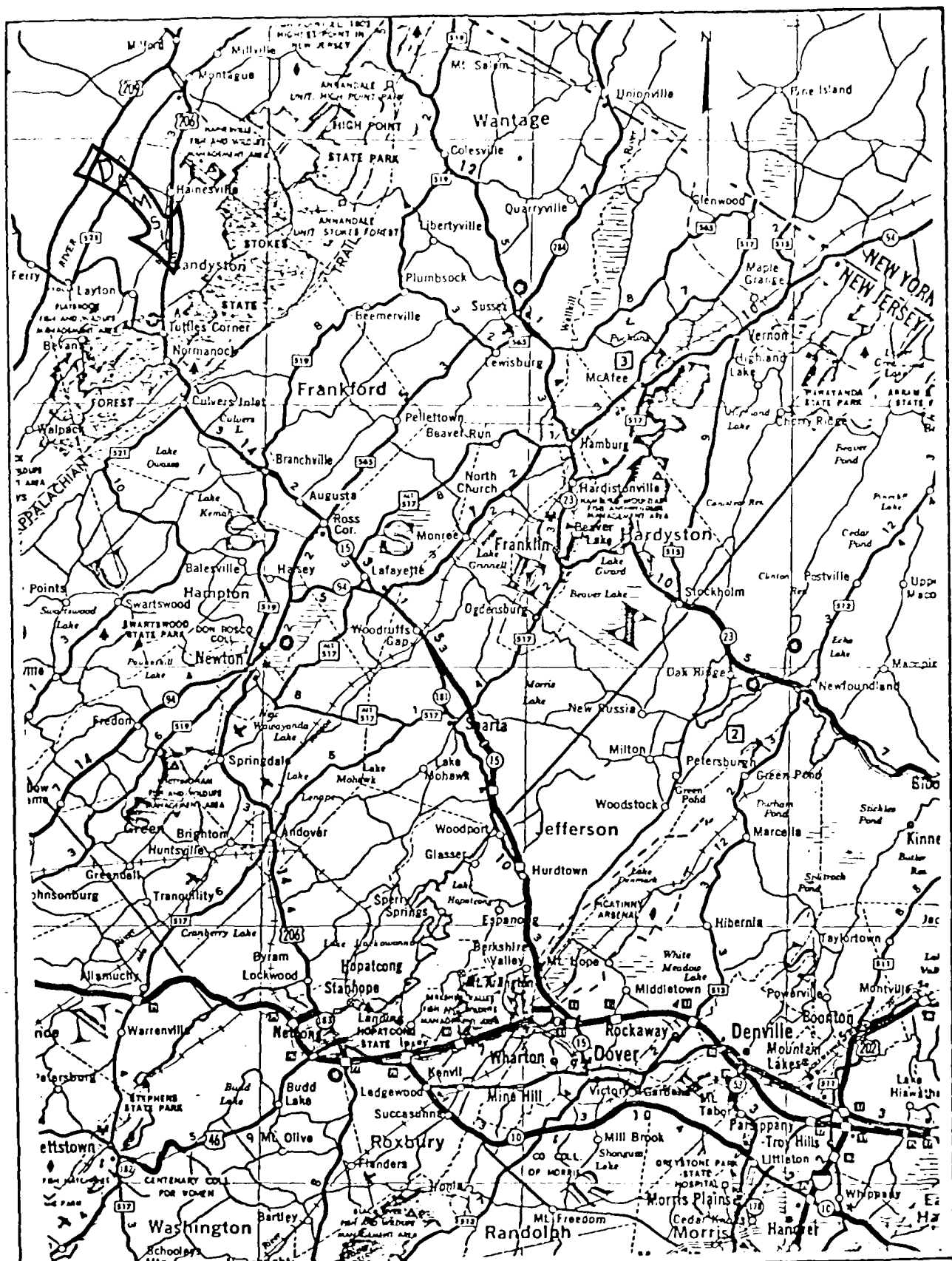
1. Determine the operating condition of the low level outlet slide gate and repair if necessary.
2. Remove the cobble dam and other obstructions from the drop inlet discharge channel.

3. Remove all branches and debris from the weirs and riser of the drop inlet spillway and provide trash racks.
4. Repair all eroded areas on the dam embankments.

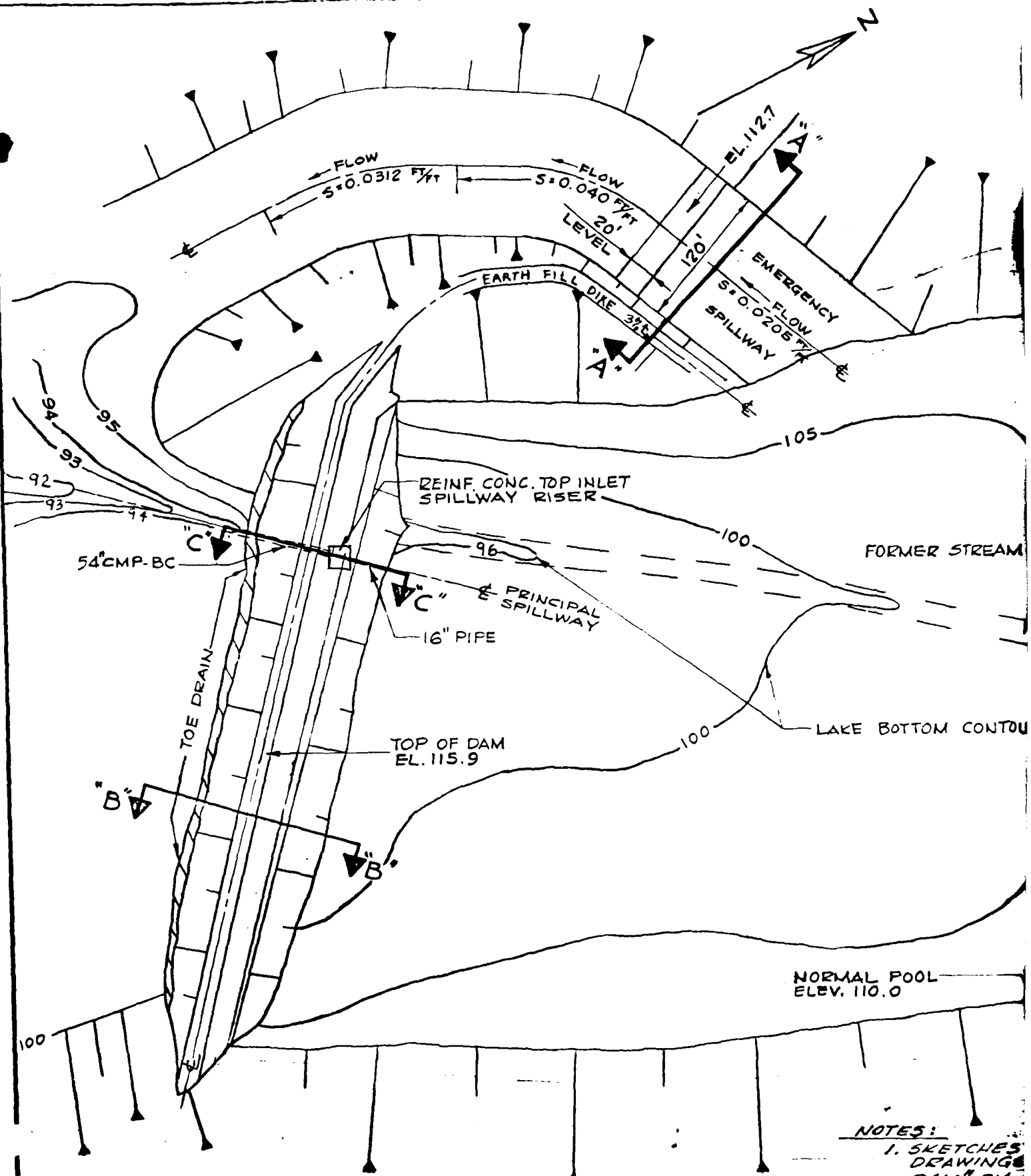
The following measures are recommended to be taken in the near future:

1. Develop written operational procedures and periodic maintenance plan to ensure the safety of the dam.
2. Perform additional investigation to determine seepage conditions through and under the dam, the engineering properties of the dam and foundation, and determine whether or not conventional safety margins exist under more severe stress conditions than those observed during our inspection, and what modifications may be required to achieve such safety margins.
3. Properly remove all trees from the embankment and provide adequate filter coverage on the downstream face to prevent any piping which may occur as a result of future root decay.

FIGURES

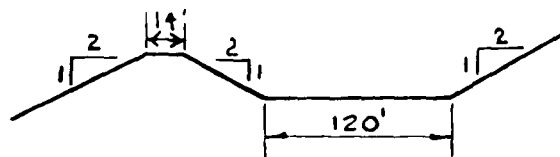


BY _____	DATE _____	REGIONAL VICINITY MAP	JOB NO. 80145
CKD _____	DATE _____	LAKE ROBERT ROOKE	FIG. 1
			SCALE: 1" = 5 MILES



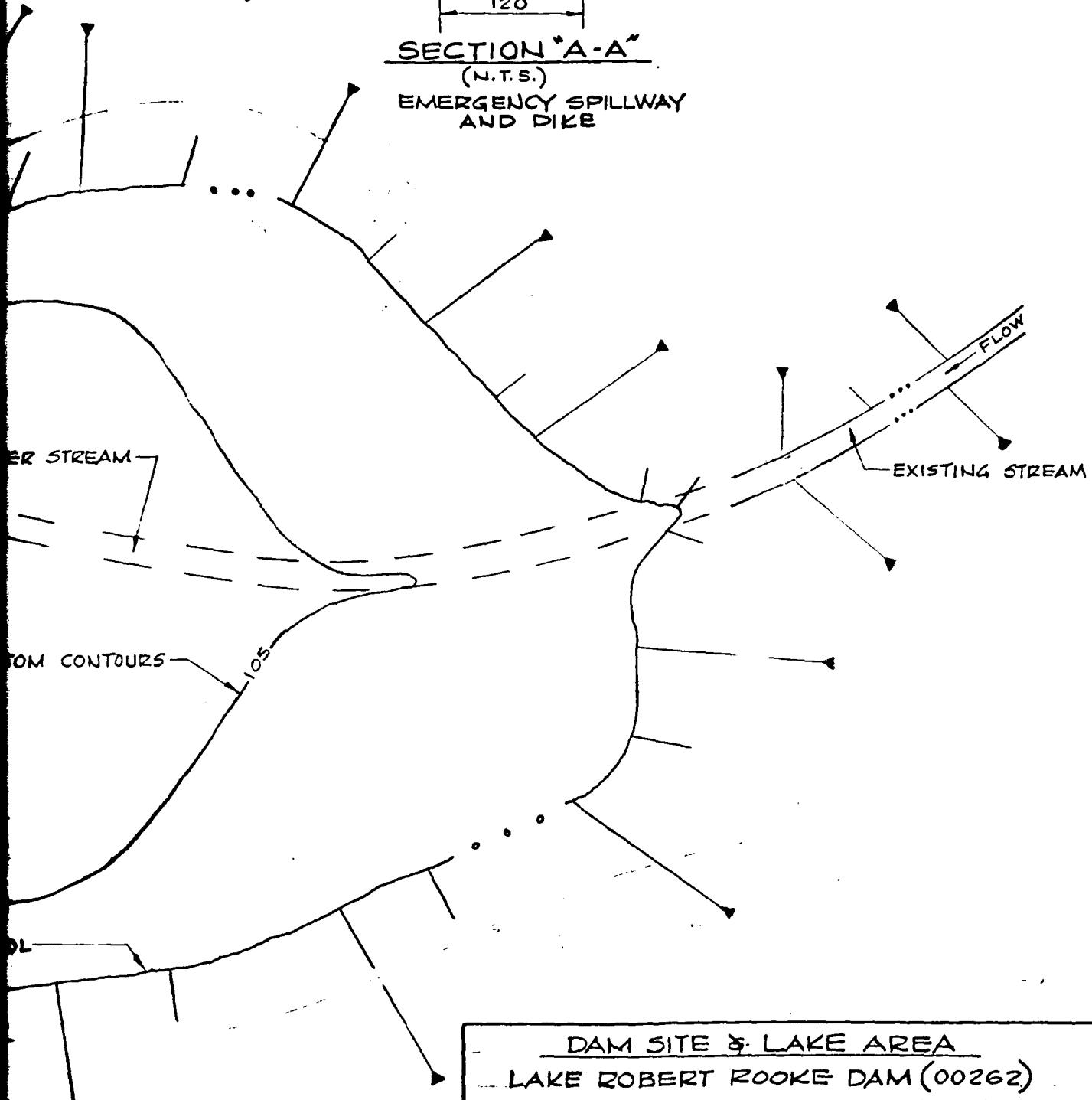
NOTES:

1. SKETCHES
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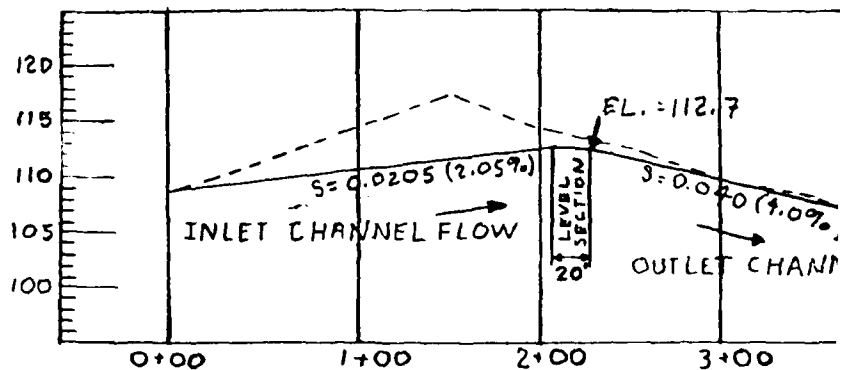
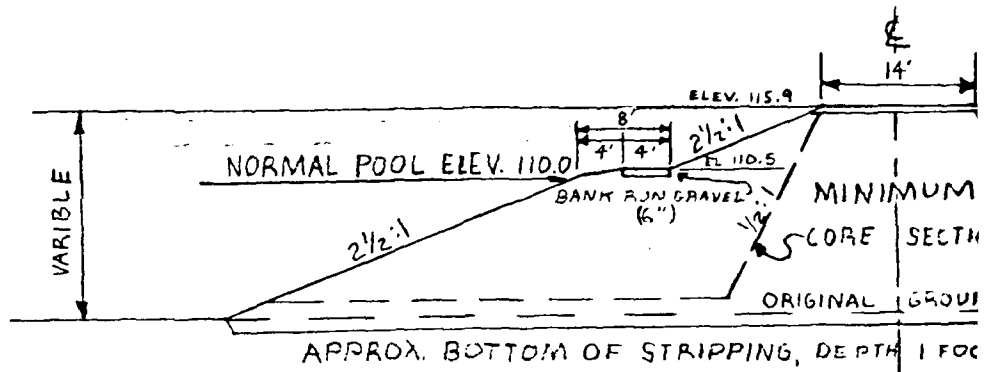
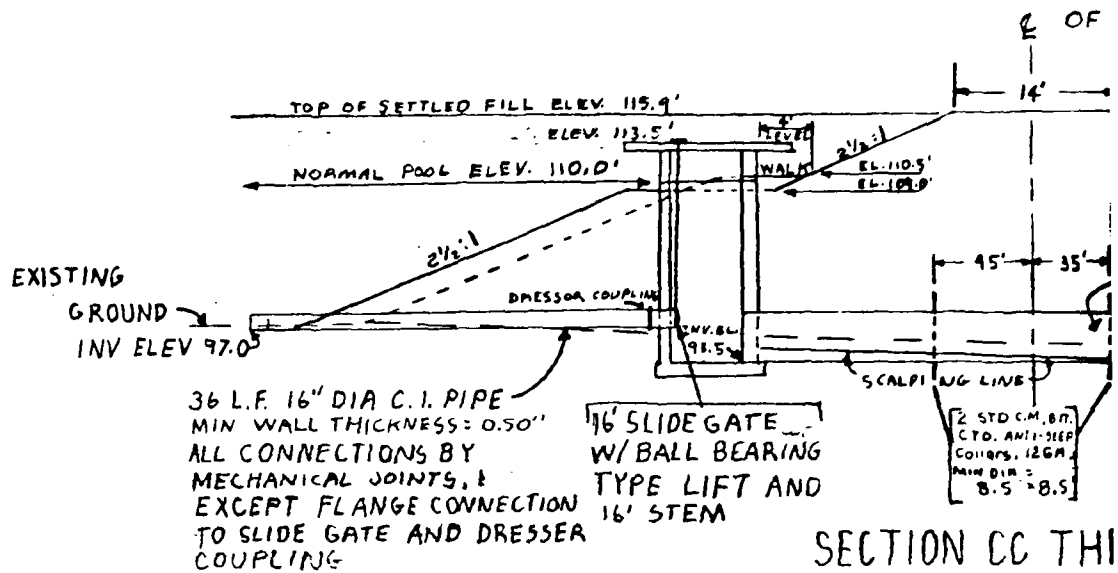
SECTION "A-A"
(N.T.S.)

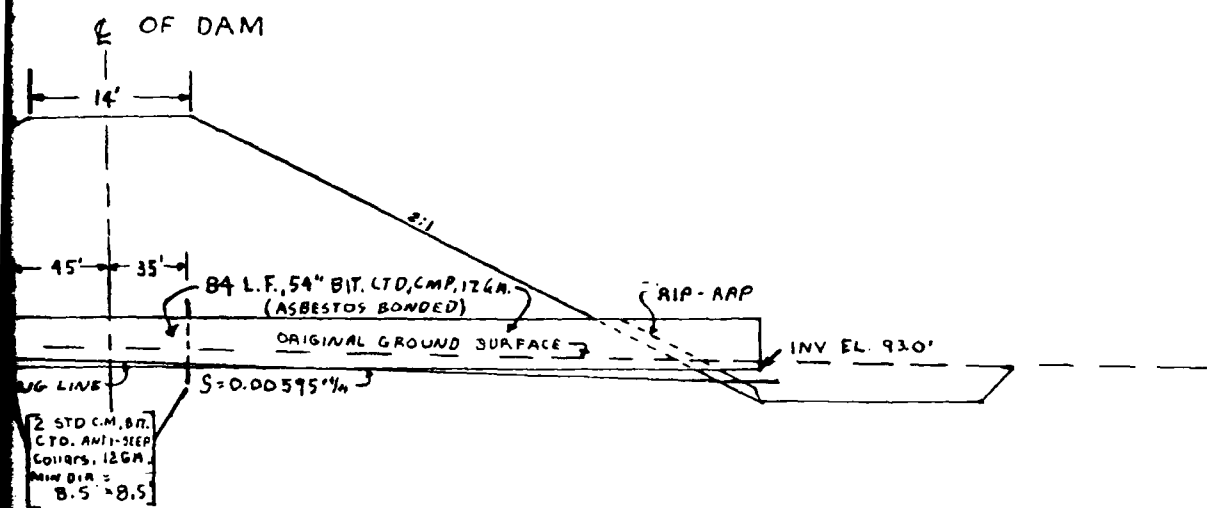
EMERGENCY SPILLWAY
AND DIKE



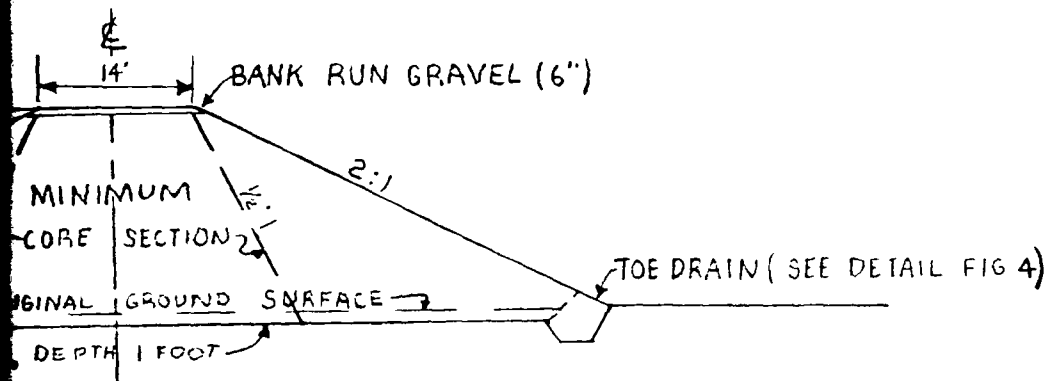
DAM SITE & LAKE AREA		
LAKE ROBERT ROOKE DAM (00262)		
SANDYSTON TOWNSHIP SUSSEX COUNTY, N.J.		
LANGAN ENGINEERING ASSOCIATES, INC.		
990 CLIFTON AVENUE CLIFTON, N.J. 07013		
DRN. BY: Mark Zadel	SCALE: NTS	JOB No. 80145
CK'D. BY:	DATE: 8 SEPT 80	FIG. No. 2

SKETCHES ADAPTED FROM DESIGN
DRAWINGS FOR NEWARK Y.M.C.A.
DAM BY U.S. DEPT. OF AGRICUL-
TURE SOIL CONSERVATION SERVICE
DATED 1963. (N.J. 625 P)
ALL ELEVATIONS ARE PLAN ELEVATIONS
USING AN ARBITRARY DATUM.

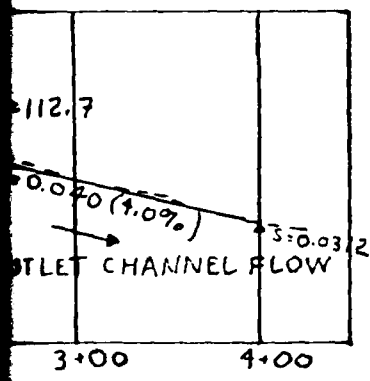




ON CC THRU C OF PRINCIPAL SPILLWAY



TYPICAL EMBANKMENT SECTION



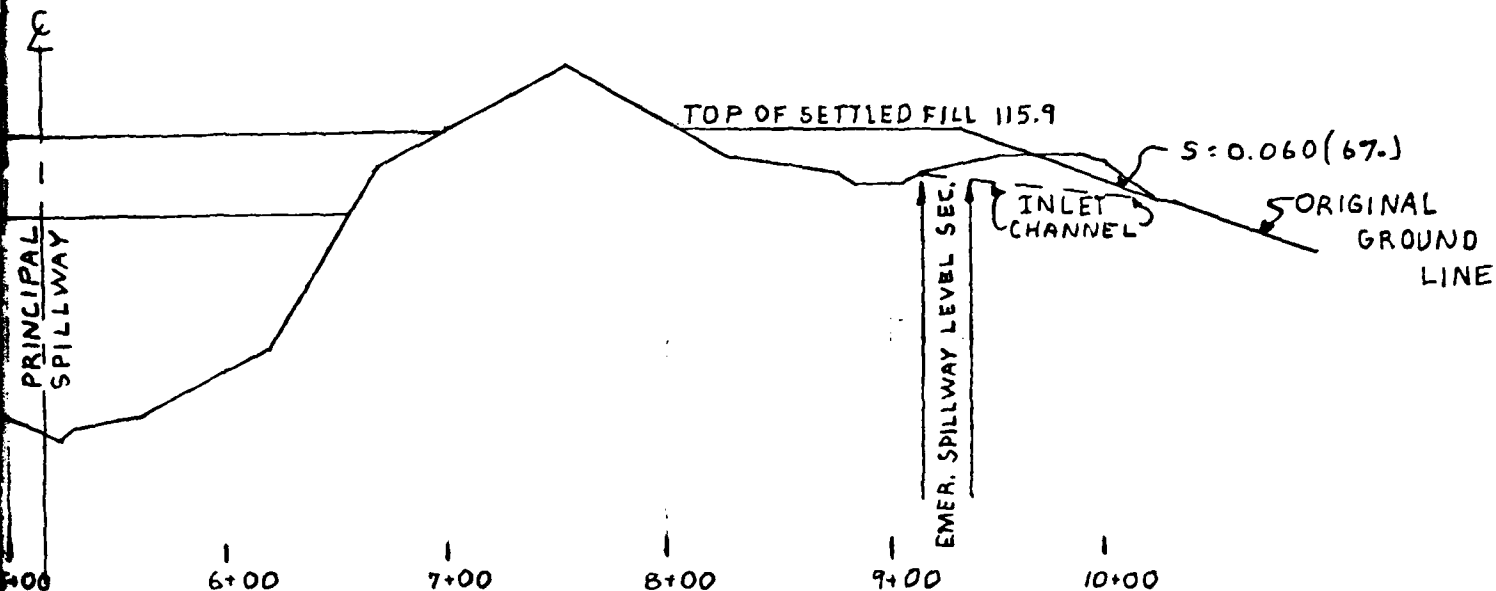
SPILLWAY

NOTES:
 1. SKETCHES ADAPTED FROM DESIGN DRAWINGS FOR "NEWARK Y.M.C.A. DAM" BY U.S. DEPT. OF AGRICULTURE SOIL CONSERVATION SERVICE DATED 1963 (N.J. 625 P)
 2. ALL ELEVATIONS ARE PLAN ELEVATIONS USING AN ARBITRARY DATUM

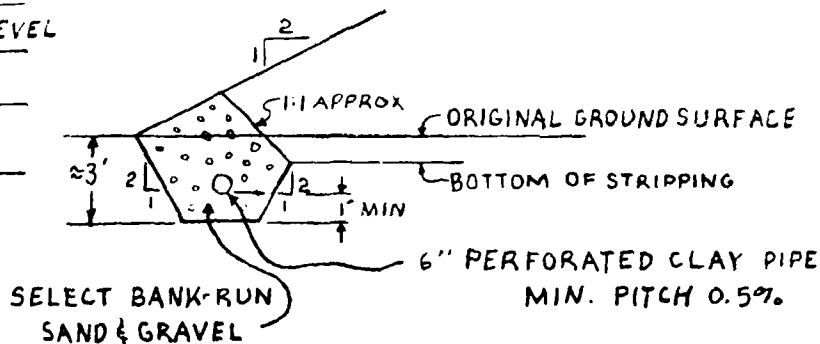
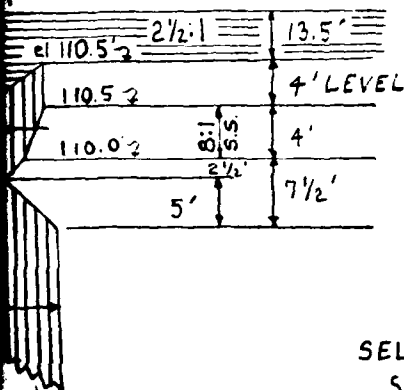
DAM SECTIONS & EMERG. SPILLWAY PROFILE		
LAKE ROBERT ROOKE DAM (00262)		
SANDYSTON TOWNSHIP		SUSSEX COUNTY, N.J.
LANGAN ENGINEERING ASSOCIATES, INC.		
990 CLIFTON AVENUE CLIFTON, N.J. 07013		
DRN. BY: Mark Zeld	SCALE: NTS	JOB No. 80145
CK'D. BY:	DATE: 9 SEPT 80	FIG. No. 3



1. SKETCHES ADAAR
FOR NEWARK Y.
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DATED 1963. (A
2. ALL ELEVATIONS
USING AN ARBIT



DAM LOOKING DOWNSTREAM

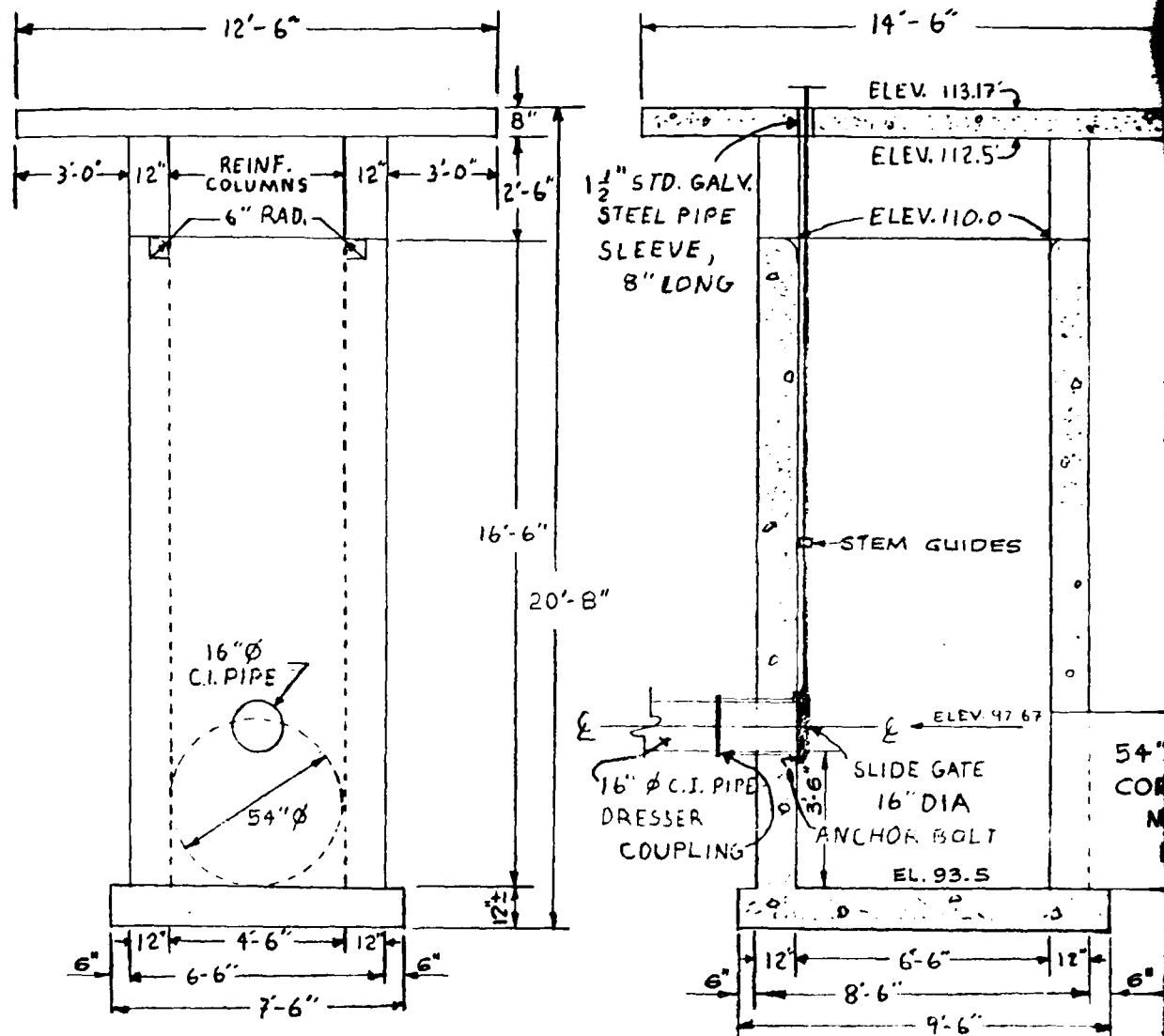


TOE DRAIN DETAIL

RISER

§ PROFILE OF DAM, PLAN OF RISER BERM AND TOE DRAIN DETAIL LAKE ROBERT ROOKE DAM (00262) SANDYSTON TOWNSHIP SUSSEX COUNTY, N.J.		
LANGAN ENGINEERING ASSOCIATES, INC. 990 CLIFTON AVENUE CLIFTON, N.J. 07013		
DRN. BY: <i>Mark Ladd</i>	SCALE: NTS	JOB No. 80145
CK'D. BY:	DATE: 9 SEPT 80	FIG. No. 4

THESE ADAPTED FROM DESIGN DRAWINGS
 NEWARK Y.M.C.A. DAM BY U.S. DEPT. OF
 AGRICULTURE SOIL CONSERVATION SERVICE
 1963 (N.J. 625 P)
 ELEVATIONS ARE PLAN ELEVATIONS
 ON AN ARBITRARY DATUM.

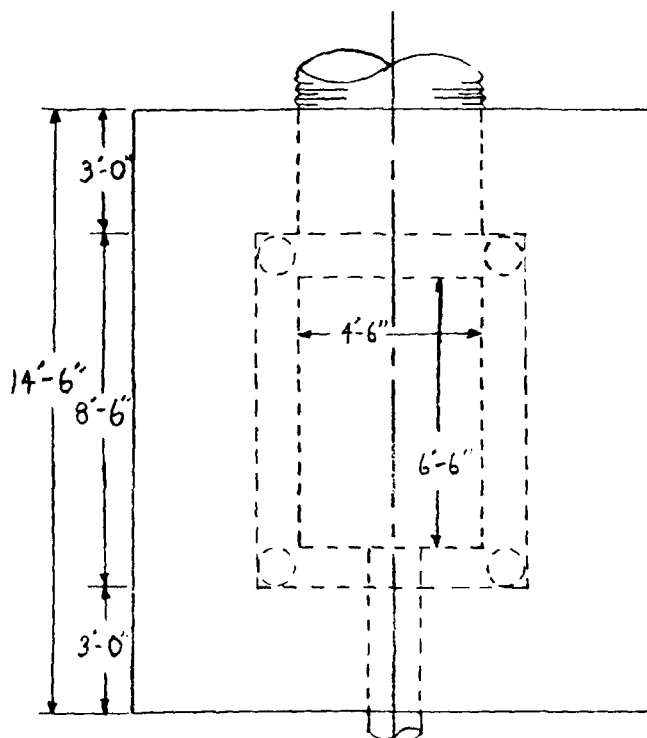
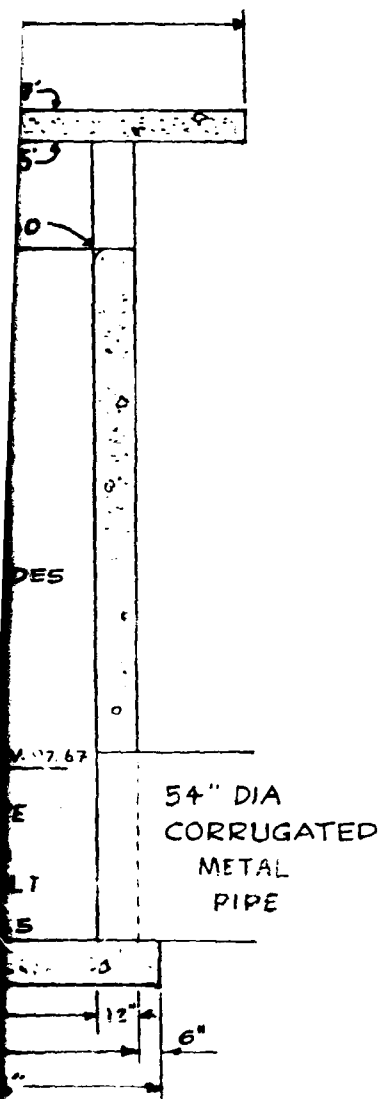


SLIDE GATE REQUIREMENTS AS SPECIFIED IN THE ORIGINAL DRAWING

1. 16" DIA. HEAVY DUTY, ARMCO MODEL 55020C OR EQUAL.
2. SEATING HEAD 0 FT.
3. UNSEATING HEAD 18 FT.
4. OPERATING HEAD 15 FT.
5. CAST IRON SEAT, SLIDE, LIFT NUTS & HAND WHEEL.
6. FLANGE BACK WITH ANCHOR BOLTS.
7. MACHINE & DRILL BACK OF FLANGE TO CONNECT WITH 16" DIA. C.I. PIPE.
8. LIFT TYPE HANDWHEEL, ARMCO MODEL H-14 OR EQUAL.
9. STEM SIZE - 7/8" DIA.
10. STEM LENGTH - 16 FT FROM \bar{C} OF GATE.
11. USE ADJUSTABLE STEM GUIDES.

NOTES:

1. SKETCHES & DRAWINGS BY U.S. DE. SOIL CONSERV. 1963 (N.J.)
2. ALL ELEVATIONS USING AN.



TOP SLAB
PLAN VIEW

DROP INLET SPILLWAY DETAILS
LAKE ROBERT ROOKE DAM (00262)

SANDYSTON TOWNSHIP SUSSEX COUNTY, N.J.

LANGAN ENGINEERING ASSOCIATES, INC.

990 CLIFTON AVENUE CLIFTON, N.J. 07013

DRN. BY: Mark Zadd

SCALE: N.T.S.

JOB No. 80145

CK'D. BY:

DATE: 9 SEPT. 80

FIG. No. 5

- NOTES:
1. SKETCHES ADAPTED FROM DESIGN DRAWINGS FOR "NEWARK Y.M.C.A. DAM" BY U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE DATED 1963 (N.J. 625 P)
 2. ALL ELEVATIONS ARE PLAN ELEVATIONS USING AN ARBITRARY DATUM.

APPENDIX I

- a. Preliminary Report, Soil and Foundation Investigation and Design, Newark YMCA Dam, Sandyston Township, New Jersey, by Woodward-Clyde-Sherard and Associates, 18 June 1963.
- b. Design Report N.J.-625-R by U. S. Department of Agriculture, Soil Conservations Service, 1963.
- c. Pertinent Design Calculations.
- d. Report on Dam Inspection, Newark YMCA Dam, Dam Application No. 564, by Mr. John H. O'Dowd, Supervising Engineer, New Jersey Division of Water Policy and Supply, 2 October 1963.
- e. Final Report, Construction Inspection, Newark YMCA Dam, Sandyston Township, New Jersey, by Woodward-Clyde-Sherard and Associates, 14 July 1980.
- f. Letter from Joseph H. Partenheimer, Vice President YM-YWCA of Newark and Vicinity, to Mr. George R. Shanklin, Chief Engineer and Director, New Jersey Division of Water Policy and Supply, 11 January 1967.

SAN FRANCISCO
SAN DIEGO

DENVER
KANSAS CITY

CHICAGO
NEW YORK

WOODWARD-CLYDE-SHERARD AND ASSOCIATES
SOIL AND FOUNDATION ENGINEERING

98 GREENWOOD AVENUE
MONTCLAIR, NEW JERSEY

Cable "Woodward-Clyde"

TELEPHONE PLAZA 8-0000
June 18, 1963
63M83

Newark YM - YWCA
600 Broad Street
Newark 2, New Jersey

Attention: Mr. Louis R. Briegal
Secretary

RECEIVED
JUN 19 1963

Preliminary Report
Soil and Foundation Investigation and Design
Newark YMCA Dam
Sandyston Township, New Jersey

Gentlemen:

Submitted herewith is our preliminary report on the soil and foundation investigation made for the proposed YMCA Dam. This work has been done in accordance with Stage I of our proposal dated April 16, 1963 and was authorized by you on April 26, 1963.

We look forward to working with you on the final design phase of this project.

Yours very truly,

WOODWARD-CLYDE-SHERARD & ASSOCIATES

Herbert L. Loddell
Herbert L. Loddell, P. E.

David M. Greer
David M. Greer, P. E.

HLL:esch

Submitted: 5 copies

**PRELIMINARY REPORT
SOIL AND FOUNDATION INVESTIGATION AND DESIGN
NEWARK YMCA DAM
SANDYSTON TOWNSHIP, NEW JERSEY**

**Report to
Newark YM - YWCA
Newark 2, New Jersey**

WOODWARD-CLYDE-SHERARD & ASSOCIATES

Woodward Clyde Sherard and Associates
CONSULTING ENGINEERS

INTRODUCTION

Following preliminary studies by the Soil Conservation Service which included hydrology, topography, spillway design, and test pits, our office was engaged to further investigate subsurface conditions in the area of the proposed dam and to develop preliminary designs and cost estimates.

A progress letter was submitted on May 16, 1963, in which the subsurface conditions encountered as of that date were described.

SCOPE OF STUDY

This investigation has included the following:

- 1) an airphoto soil and geologic analysis of the area;
- 2) borings, test pits, and a seismic refraction survey at the dam site;
- 3) test pits in potential borrow areas;
- 4) analysis of conditions and general recommendations pertaining to the dam design; and
- 5) a preliminary cost estimate for the project.

FIELD INVESTIGATION

Two borings were made along the center line of the proposed dam where shown on Plate 2. Both of these borings were cored five feet into bedrock.

Seismic refraction lines were run both along the center line and at right angles to the center line, for the purpose of locating the depth of bedrock, and to correlate the general distribution and characteristics of the subsolls in the valley with those found in the borings.

Test pits to depths of about 6 to 8 feet were dug both by the Soil Conservation Service and our personnel at the dam site. The location of these pits are shown on Plate 2.

Test pits were also dug by our personnel upstream from the small lake at Camp McDonald where consideration is being given to extending the lake and at the same time utilizing this material for the dam. Other test pits were dug about 500 to 700 feet east of the entrance to Camp Linwood, and just to the north of Flat Brook Road in the search for potential embankment material.

Descriptions of the materials encountered in the borings and test pits are shown in the logs, Plates 7 through 13. A key to soil symbols is presented as Plate 6.

The seismic velocities, which are indications of the density and nature of the materials explored by this method are noted on the profiles, Plates 3 and 4.

GENERAL SUBSURFACE CONDITIONS AT DAM SITE

A generalized subsurface profile across the dam site is presented as Plate 3.

The borings and seismic refraction survey revealed rock to be at a depth of about 10 feet below the surface at the north slope of the valley, then gradually dropping off to a maximum depth of 35 to 40 feet across the southern half of the valley. The soil overburden is essentially composed of a dense glacial "till", which according to examination of the samples and grain size curves, is a well-graded silty gravelly coarse to fine sand with varying amounts of cobbles and boulders. The percentage of silt fines in the till appears to generally vary from about 10 to 15%, although one sample indicates that there are probably localized zones with smaller amounts of silt.

There is about one foot of topsoil (organic matter and roots) over the general area. Below the topsoil there is generally found two or three feet of impervious material, consisting of stiff silty clays or fine sandy clayey silts.

The average depth to groundwater is three to four feet below the valley floor.

LABORATORY TESTING

Six grain-size analyses were run on representative samples of foundation materials at the dam site, and one grain-size test was run on a sample of good potential embankment core material to serve as a check on visual classification. In addition, two moisture contents and two sets of Atterberg Limits were run on samples of fine-grained soils. These results are shown on Plates 14 and 15.

DISCUSSION AND RECOMMENDATIONS

General Design Criteria - The following elevations have tentatively been established which satisfy the requirements of the State of New Jersey :

Crest Elevation : 117.2

Design High Water Level: 115.4

Normal Water Level: 110.0

Evaluation of Dam Foundation Soils - The main problem in this investigation has been to determine if the soils beneath the valley floor are sufficiently impervious to prevent any large-scale leakage beneath the dam. The percentage of fines (10 - 15% silt) found in the typical dense, well-graded till samples is enough to make this stratum generally semi-impervious. There is the possibility of localized pervious zones or lenses in such a mass of material which could conceivably cause large-scale, troublesome leakage; but the chances of such leakage are believed to be remote. The impervious soil mantle which blankets the valley floor should act as a protective barrier against subsurface leakage. Based on an evaluation of these factors, it is our opinion that conditions are favorable for the construction of the dam and that it can be built economically, without resorting to expensive cutoff walls or trenches.

Embankment Design - On Plate 5 are shown tentative typical sections for the proposed dam which we believe will produce an economical, stable, and relatively impervious structure. The final design will depend upon further exploration and availability of borrow materials.

No cutoff trench has been provided in the embankment design because construction of such a trench would require breaking through the im-

4

pervious mantle that now exists, and the use of well-points during construction because of the high water table. The expense of such a cutoff trench would be great relative to the cost of the entire project; and the reduction in seepage which it would accomplish would only be nominal unless the trench was taken to a considerable depth. A mud slurry cutoff trench to rock would be very effective, as a cutoff wall, but would cost more than the embankment itself. Therefore, it is recommended that the embankment be constructed as shown after the topsoil has been stripped off; and that care be taken in construction, to permit only a minimum of disturbance to the upper impervious mantle.

The purpose of the toe drain shown in the tentative sections is to collect such seepage as does find its way through the dam, and some of the foundation seepage as well, thus maintaining a relatively dry surface outside the toe of the dam.

Borrow Sources - The material encountered upstream from the small lake at Camp McDonald is very gravelly and contains many cobbles and boulders. By the time this material is excavated from below the water level (which is necessary if the lake is going to be extended), much of the fine-grained soil present in it will be washed out. Therefore, soil from this source will be suitable for "random" pervious fill, but cannot be used for core material.

The material found just to the north of Flat Brook Road and across the ridge from the proposed lake is a gravelly, sandy, slightly clayey silt (see grain-size curve on Plate 15, TP - L1) which is excellent core material.

It is planned to explore other sources within the property, including the upstream section of the proposed lake. This source would involve a short haul and no destruction of woodland; but it should be pointed out that there is a danger of opening seepage channels in the valley floor which could lead to large seepage losses. It is our opinion at this time that the valley floor should be left untouched.

Before final selection of borrow areas is made, it appears that the following factors must be carefully weighed:

It is recommended that a valve be built into the intake system to permit draining of the lake.

On Table I is submitted a preliminary cost estimate for the project.

It is believed that additional borings at the dam site will not reveal conditions that would alter present recommendations; and, therefore, they are considered unnecessary in the event it is decided to go ahead with the project. Future field work should be devoted to further exploration of borrow sources so that the type and amounts of materials to go into the embankment will be established for design purposes, and to define borrow areas well in advance of construction.

WILLIAM D. VAN SICKLE and ASSOCIATES
6000 VAN DYKE AVE. SUITE 4000

Transportation Services and Administration

COST ESTIMATE

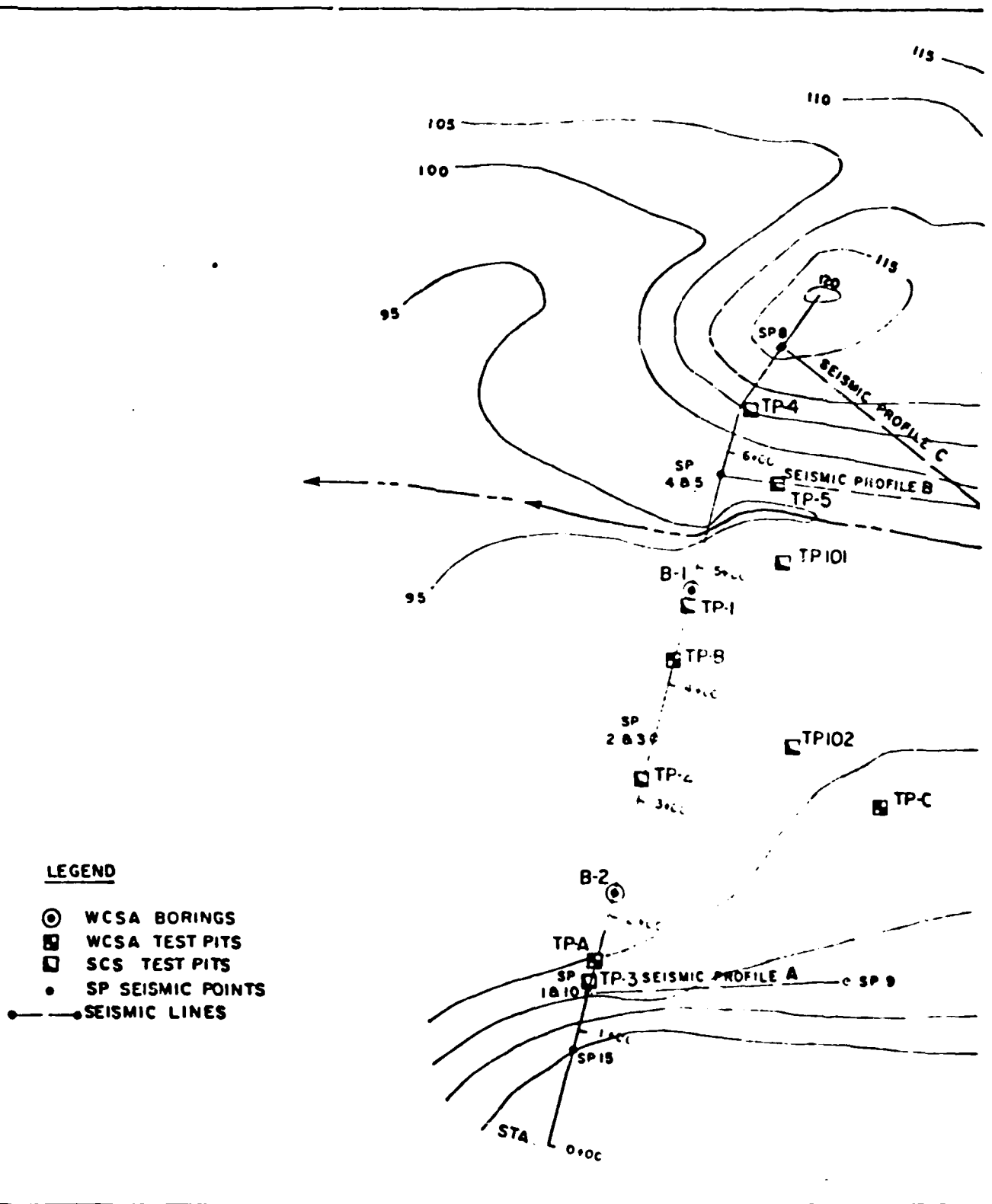
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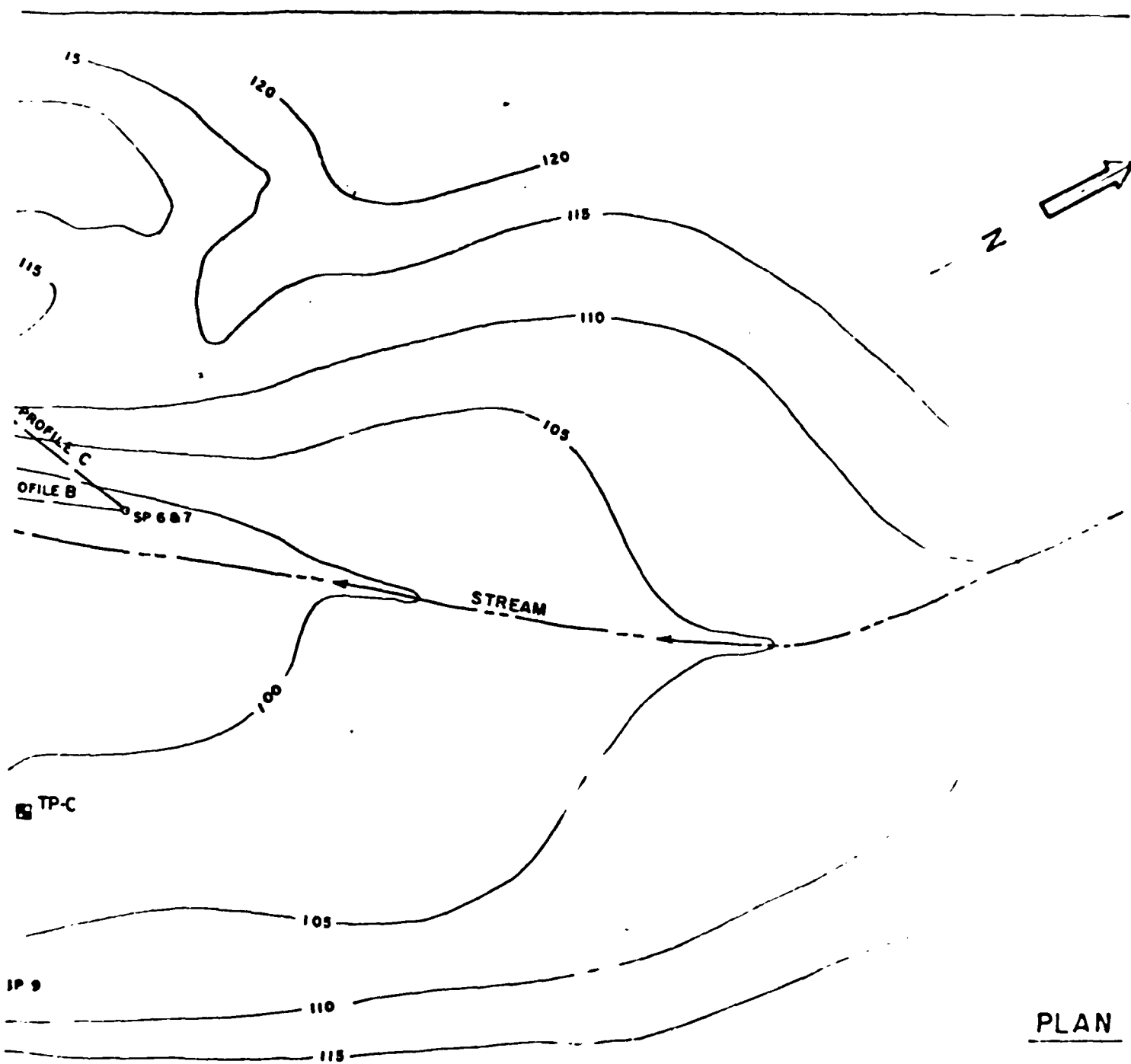
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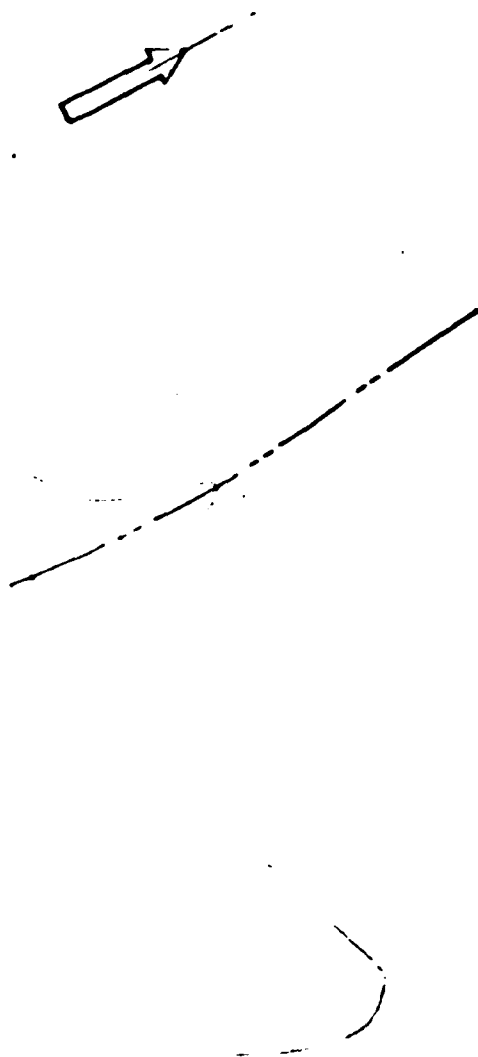


PLATE I

63 M 83







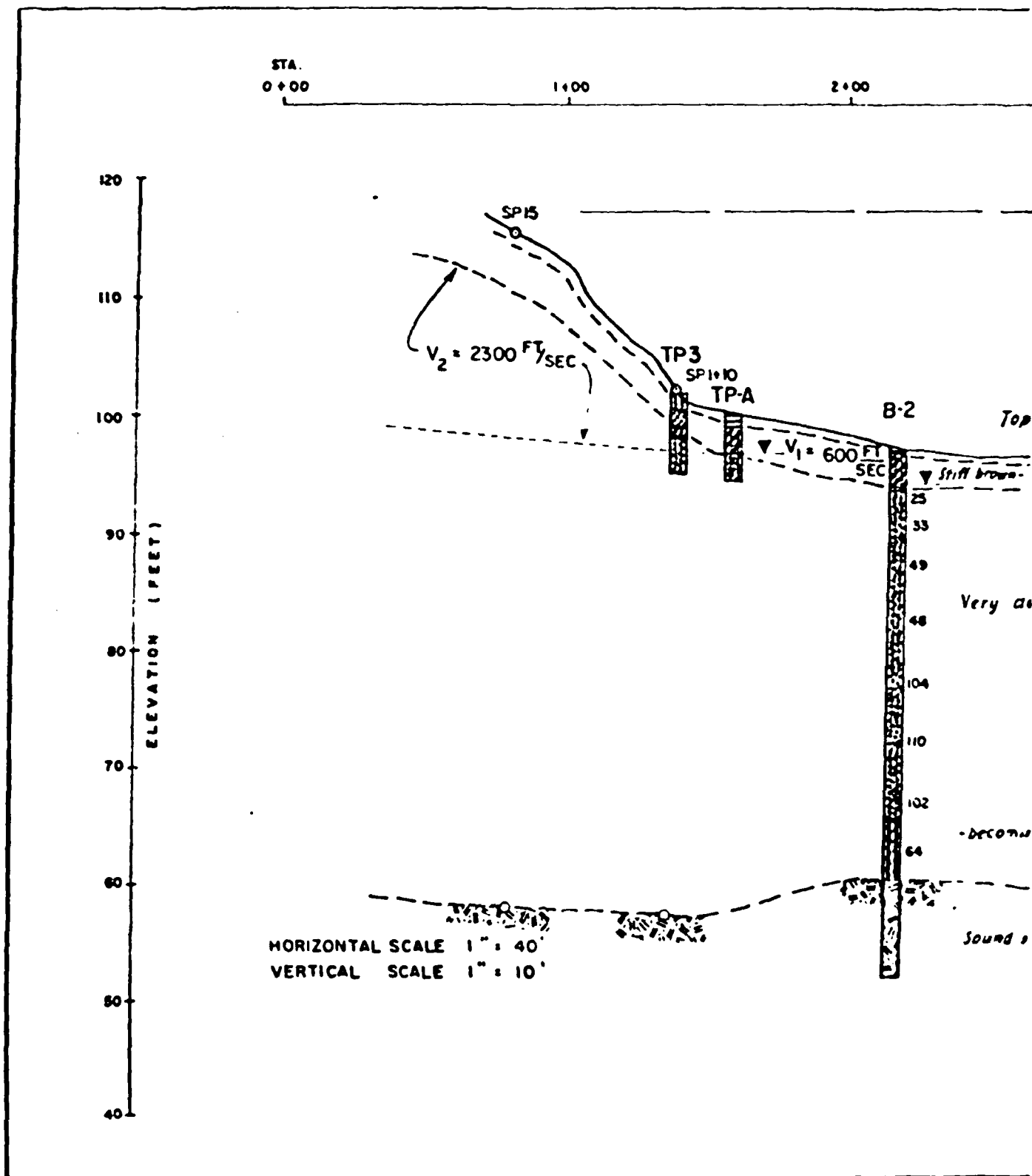
PLAN OF BORINGS, TEST PITS & SEISMIC LINES

PROPOSED NEWARK YMCA DAM
SANDYSTON TWP, SUSSEX CO, N.J.

SCALE 1" = 100'

PLATE 2

63 MB3



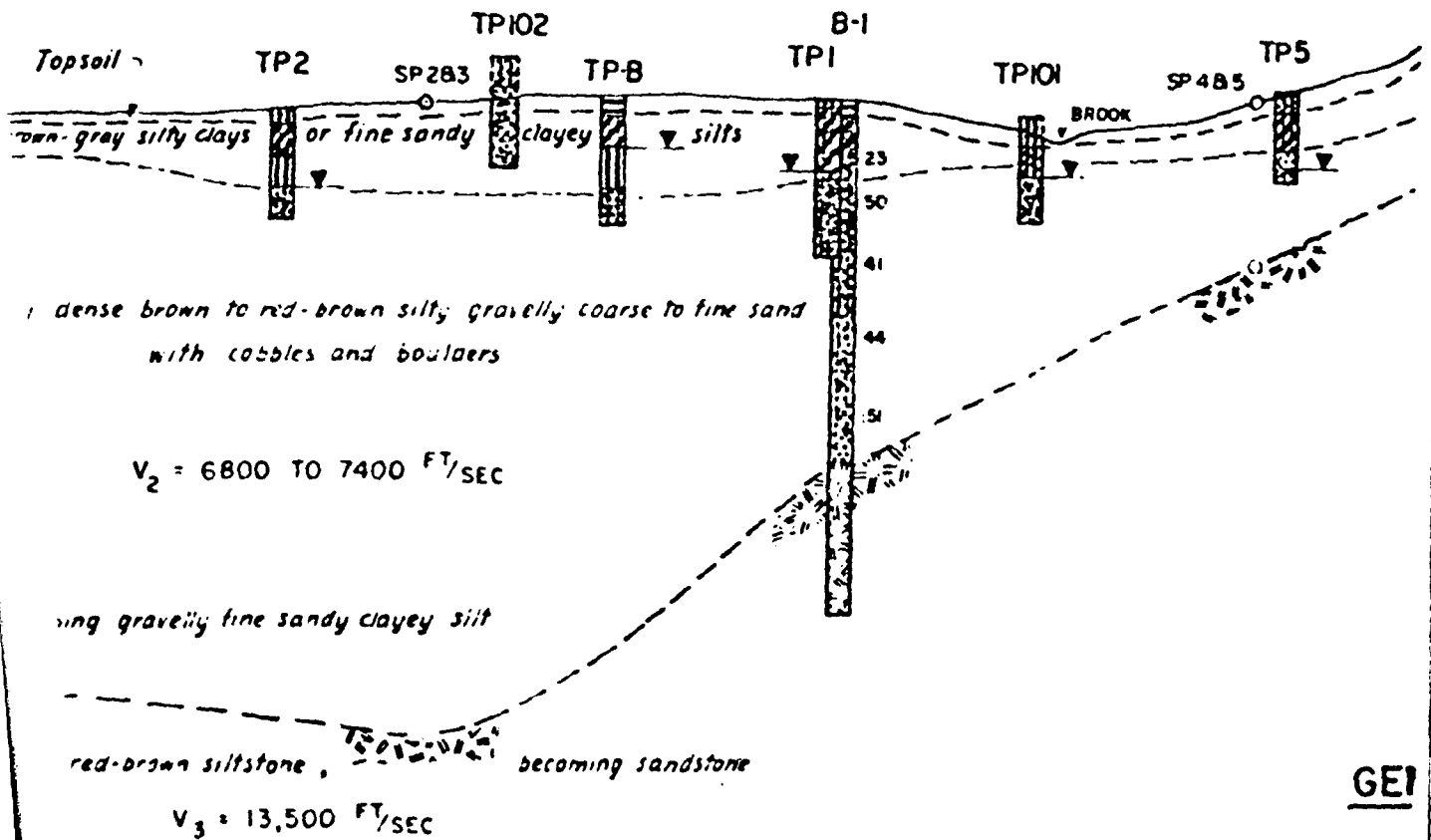
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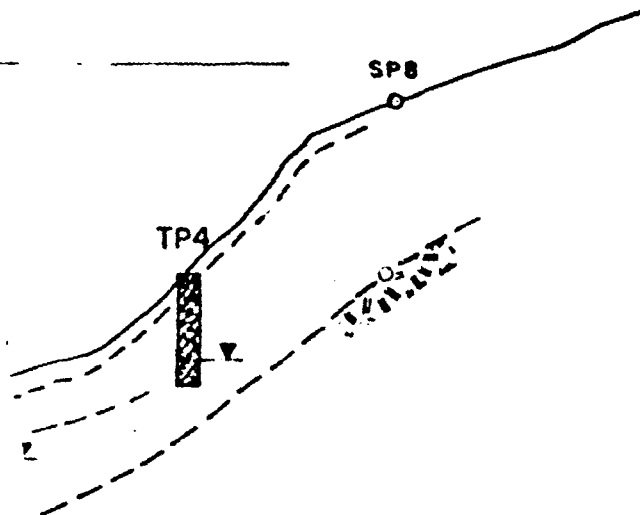
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EL. 117.2 TENTATIVE DAM CREST



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NOTES

FIGURES NEXT TO BORINGS DENOTE
SAMPLING RESISTANCE (SEE KEY, PLATE 6)

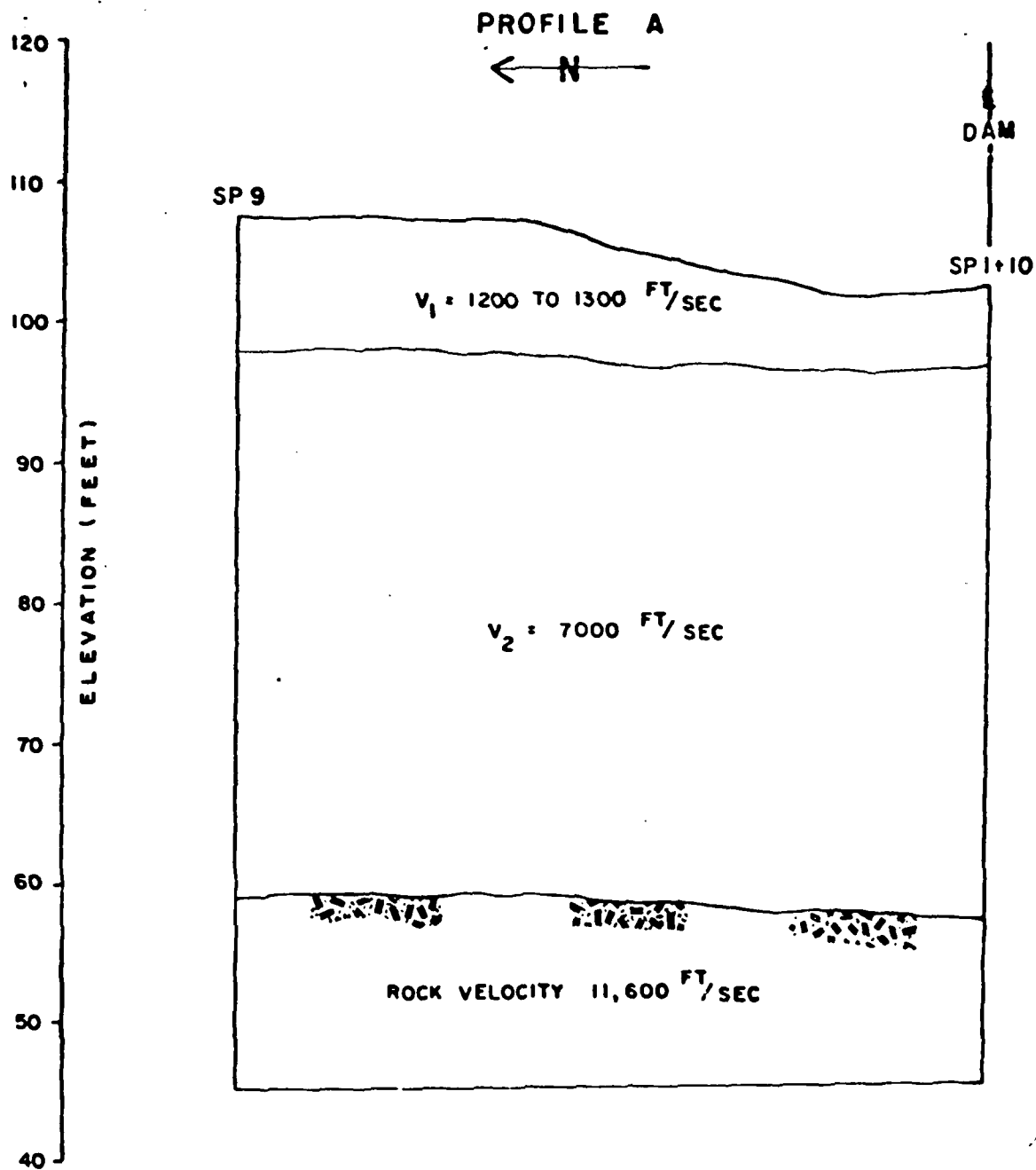
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SEISMIC POINT

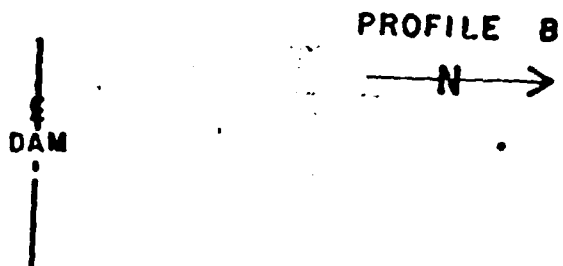
VERALIZED SOIL PROFILE

PROPOSED NEWARK YMCA DAM
SANDYSTON TWP, SUSSEX CO, N J

PLATE 3

63 M 83

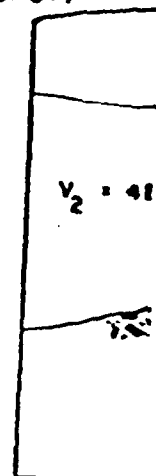
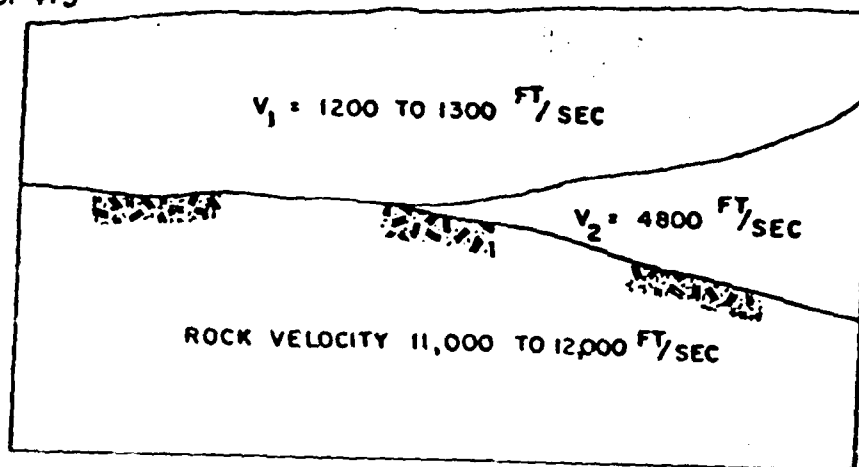




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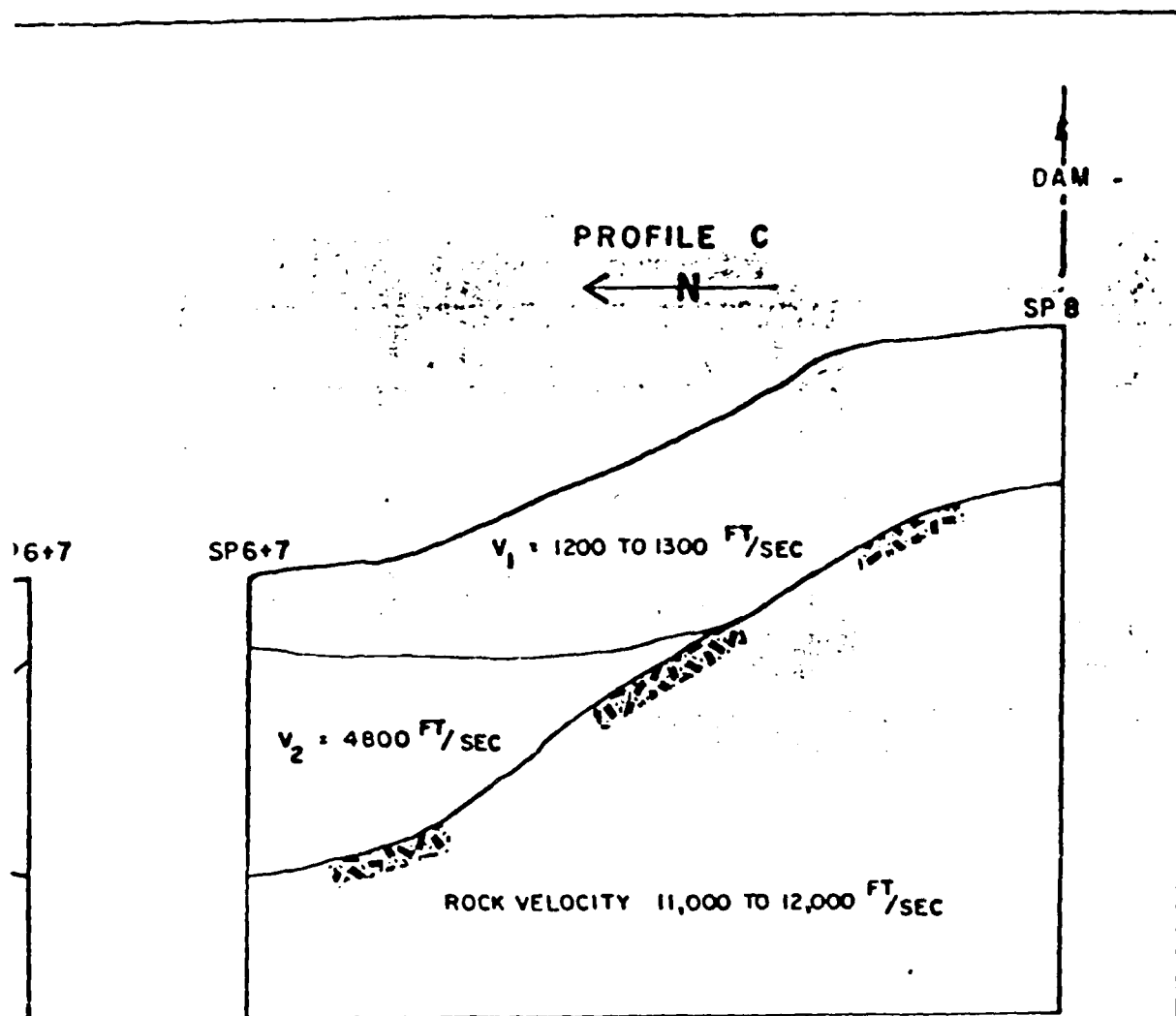
SP6+7

SP6+7



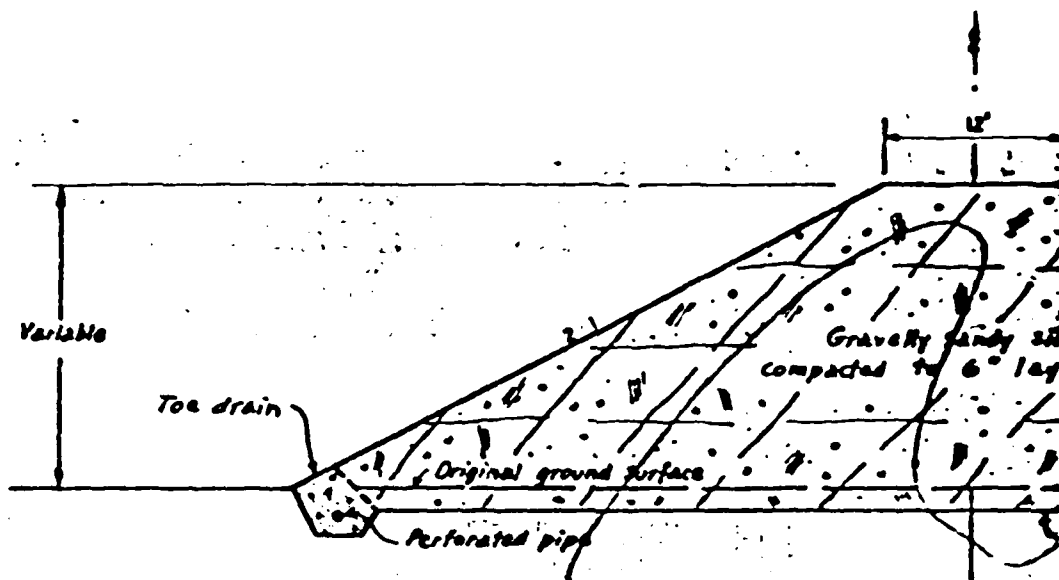
HORIZONTAL SCALE 1" = 40'

VERTICAL SCALE 1" = 10'

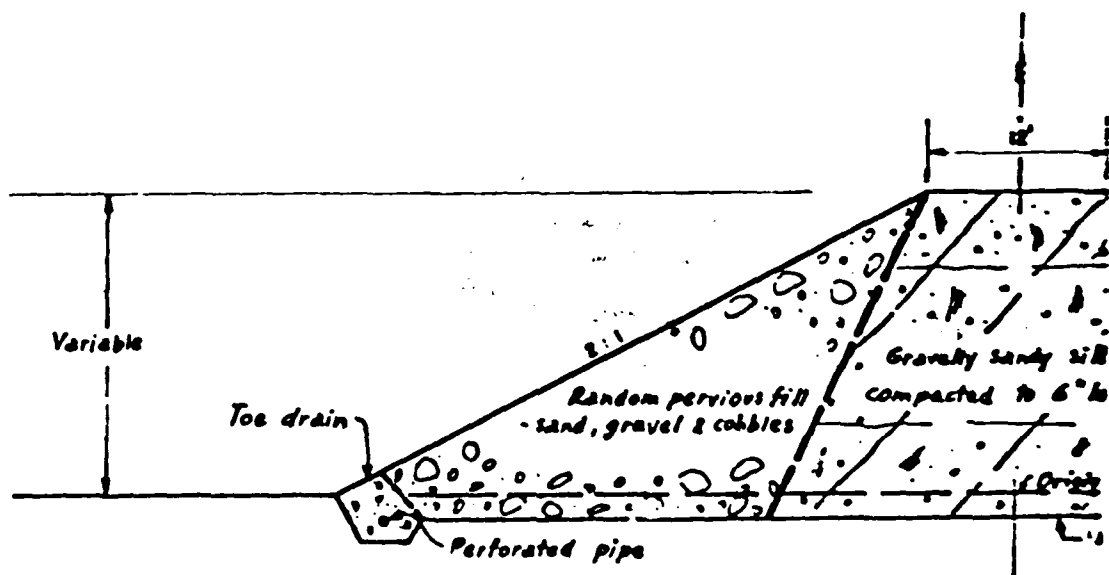


SEISMIC PROFILES

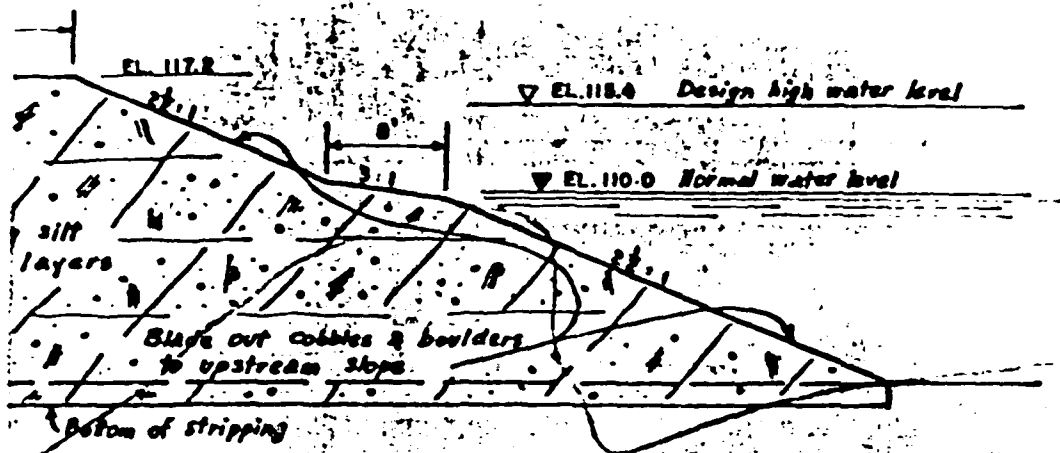
PROPOSED NEWARK YMCA DAM
SANDYSTON TWP., SUSSEX CO., N. J.



TYPICAL SECT
(PRELIMINARY)



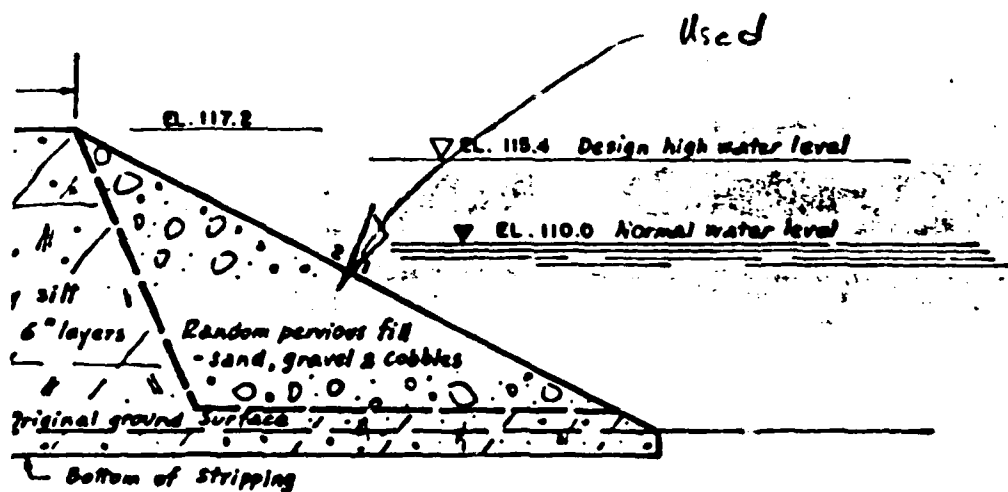
ALTERNATE SE
(PRELIMINARY)



SECTION

ARY)

HORIZONTAL SCALE 1" = 10'
VERTICAL SCALE 1" = 10'



SECTION

ARY)

used

PROPOSED NEWARK YMCA DAM

SANDYSTON TWP., SUSSEX CO., N.J.

PLATE 5

KEY TO SOIL SYMBOLS AND TERMS

Terms used in this report for describing soils according to their texture or grain size distribution are in accordance with the Unified Soil Classification System, as described in Technical Memorandum No. 3-387, Waterways Experiment Station, March 1953.

TERMS DESCRIBING CONSISTENCY OR CONDITION



Gravel



Gravelly



Sand



Sandy



Silt



Silty



Clay



Clayey



Organic matter



Organic



Rock



Shale

Topsoil

Misc. Fill

Sample Recovered

Sample Not Recovered

COARSE GRAINED SOILS (major portion retained on No. 200 sieve) includes (1) clean gravels and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as determined by laboratory tests.

Descriptive Term

Relative Density

Very loose

0 to 15%

Loose

15 to 40%

Medium dense

40 to 70%

Dense

70 to 85%

Very dense

85 to 100%

FINE GRAINED SOILS (major portion passing No. 200 sieve) includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests.

Descriptive Term

Unconfined Compression Strength, tons/sq. ft.

Penetrometer Reading pounds on 0.25 in. dia. area

Very soft

less than 0.25

less than 2.5

Soft

0.25 to 0.50

2.5 to 5.0

Firm

0.50 to 1.00

5.0 to 10.0

Stiff

1.00 to 2.00

10.0 to 20.0

Very stiff

2.00 to 4.00

20.0 to 40.0

Hard

4.00 and higher

40.0 and higher

*Note: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

SAMPLING RESISTANCE

15 - The number of blows (15) of a 140-pound hammer falling 30 inches used to drive a 2" O.D. split-barrel sampler for the last 12 inches of penetration.

50/2 - Number of blows (50) used to drive the split-barrel a certain number of inches (2).

WR - Split-barrel advanced by the weight of rods only.

WH - Split-barrel advanced by the weight of the hammer and rods.

R - Refusal, sampler could not be advanced further.

P - 3" O.D. Shelby tube sample.

P250 - 3" O.D. Shelby tube pushed hydraulically, using a certain pressure (250 psi) to push the last 6 inches.

PWR - 3" O.D. Shelby tube advanced 24 inches by the weight of rods only.

Aug. - Auger sample.

AX - Rock cored with AX core barrel, which obtains a 1-1/8" diameter core.

NX - Rock cored with NX core barrel, which obtains a 2-1/8" diameter core.

65% - Percentage (65) of rock core recovered.

P_p - Piston sample.

LABORATORY TEST IDENTIFICATION

C - Consolidation and specific gravity tests performed.

D - Relative density test performed.

K - Permeability test performed.

M - Mechanical (sieve or hydrometer) analysis performed.

T - Triaxial compression test performed.

U - Unconfined compression test performed.

V - Vane shear test performed.

LOG OF BORING NO. 1

DATE 4/29 - 5/1/63

SURFACE ELEV. 97

LOCATION See Plate 2

DEPTH, FEET	SAMPLES	SAMPLING RESISTANCE	SYMBOL	DESCRIPTION	Elevation
0				Organic matter and roots	97.0
25				Stiff gray brown silty clay with cobbles	93.2
50				Very dense brown silty gravelly coarse to fine sand (Glacial Till)	
43					
44					
151					74.0
25	R AX 79%			Sound red-brown siltstone	
28%	AX				
74%	AX				64.5
35					

COMPLETION DEPTH 32.5'

WATER DEPTH 3.4'

DATE 5-1-63

SAMPLER: 2-INCH O.D. SPLIT BARREL

LOG OF BORING NO. 2

DATE 5/2 - 5/3/63

SURFACE ELEV. 97

LOCATION See Plate 8

DEPTH, FEET	SAMPLES	SAMPLING RESISTANCE	SYMBOL	DESCRIPTION	Elevation
0					97.0
				Organic matter	
25	Aug			Dense yellow-brown fine sandy silty clay	93.5
33				Very dense red-brown silty gravelly coarse to fine sand	
10	49			(Glacial Till)	
				... with many cobbles & boulders, very difficult drilling	
20		108			
		110			
30		102			65.0
				Hard gravelly sandy clayey silt	
	64				60.0
40	AX 96%			Limestone with siltstone, sound	
	AX 92%			- becoming sound red-brown sandstone	
	AX 95%				51.5
50					

COMPLETION DEPTH 45.5'

WATER DEPTH 2.0'

DATE 5.3.63

SAMPLER 2-INCH OD SPLIT BARREL

LOG OF TP-A

DATE 1-1-63 SURFACE ELEV. _____ LOCATION See Plate 2

DEPTH, FEET SAMPLES	SYMBOL	DESCRIPTION	Moisture Content %	Atterberg Limits
0		Organic matter and roots		
		Light gray brown silty clay with occasional cobbles	27	37 20
5		Brown silty gravelly sand and gravel with cobbles		
10				

COMPLETION DEPTH 6' WATER DEPTH 3.0'

LOG OF TP-B

DATE 1-1-63 SURFACE ELEV. _____ LOCATION See Plate 2

DEPTH, FEET SAMPLES	SYMBOL	DESCRIPTION
0		Organic matter and roots
		Mottled gray brown silty clay
5		Gray fine sandy silt
		Light brown silty gravel and sand
10		

COMPLETION DEPTH 8' WATER DEPTH 3.0'

DATE 1-1-63 SURFACE ELEV. LOCATION 8- Plate 2

DATE 1-1-63

SURFACE ELEV.

LOCATION 8.~ Plate 2

COMPLETION DEPTH 6' WATER DEPTH 3.0'

DATE _____ SURFACE ELEV. _____ LOCATION _____

DATE _____

SURFACE ELEV.

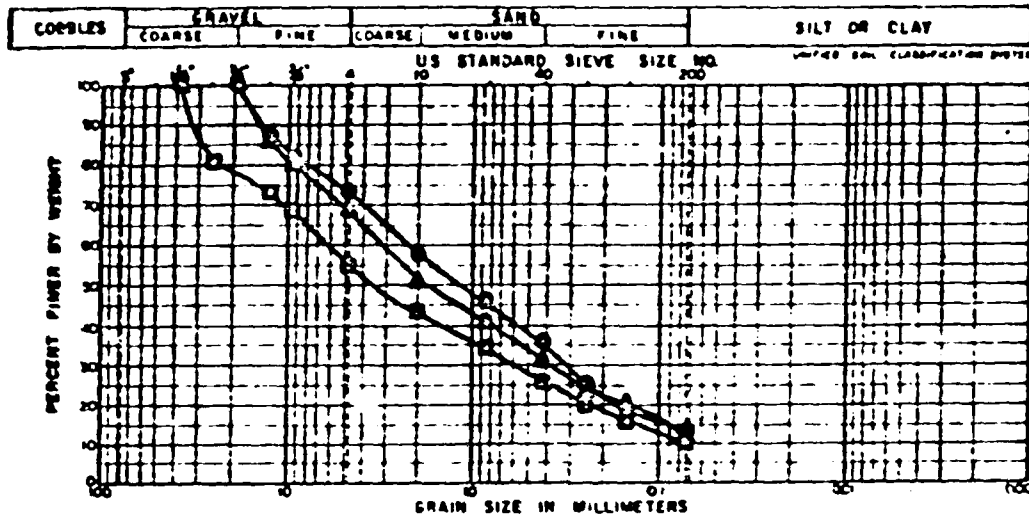
LOCATION

COMPLETION DEPTH _____ WATER DEPTH _____

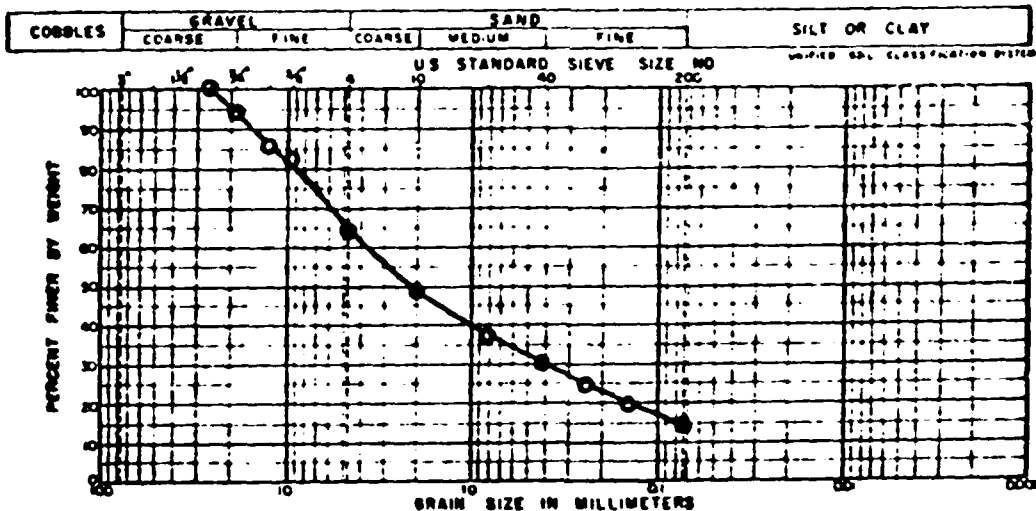
LOG OF TP-L1		About 500 feet east of Camp entrance and 100' n. of Flat Brook Road
DATE _____	SURFACE ELEV. _____	LOCATION _____
DEPTH, FEET	SAMPLES	SYMBOL
0		
		DESCRIPTION
		Topsoil and roots
5		Light brown gravelly sandy slightly clayey silt with occasional cobbles and boulders
10		
COMPLETION DEPTH <u>12</u>		WATER DEPTH _____

LOG OF TP-L2		About 700 feet east of Camp entrance and 150' n. Flat Brook Road
DATE _____	SURFACE ELEV. _____	LOCATION _____
DEPTH, FEET	SAMPLES	SYMBOL
0		
		DESCRIPTION
		Topsoil
5		Light brown gravelly sandy slightly clayey silt with occasional cobbles and boulders
10		
COMPLETION DEPTH <u>10'</u>		WATER DEPTH _____

MECHANICAL ANALYSIS

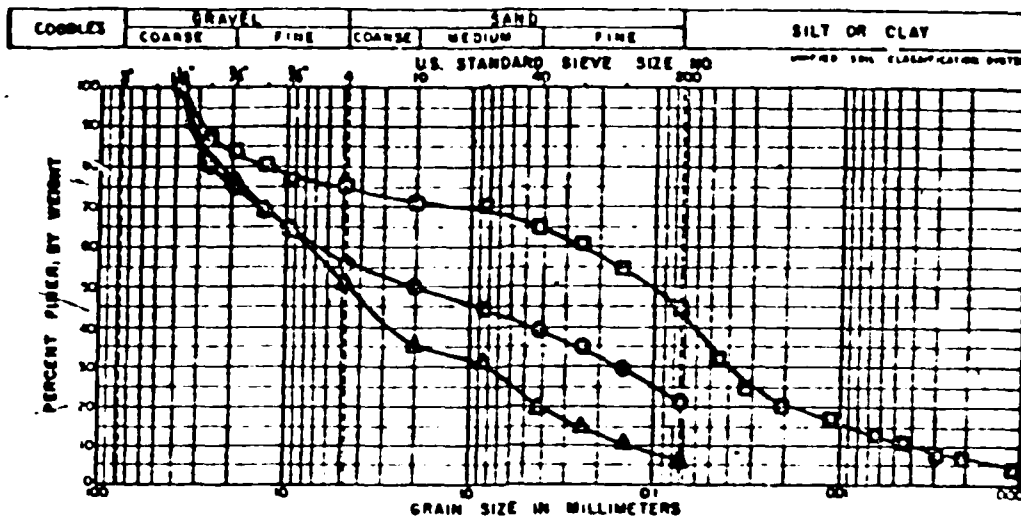


BORING	SAMPLE	DEPTH	SYMBOL	CLASSIFICATION	MC	LL	PL
1	2	6.9'-7.5'	○	Silty gravelly coarse to fine sand			
1	3	10.0'-11.0'	△	Silty gravelly coarse to fine sand			
1	4	15.0'-16.0'	□	Silty gravelly coarse to fine sand			

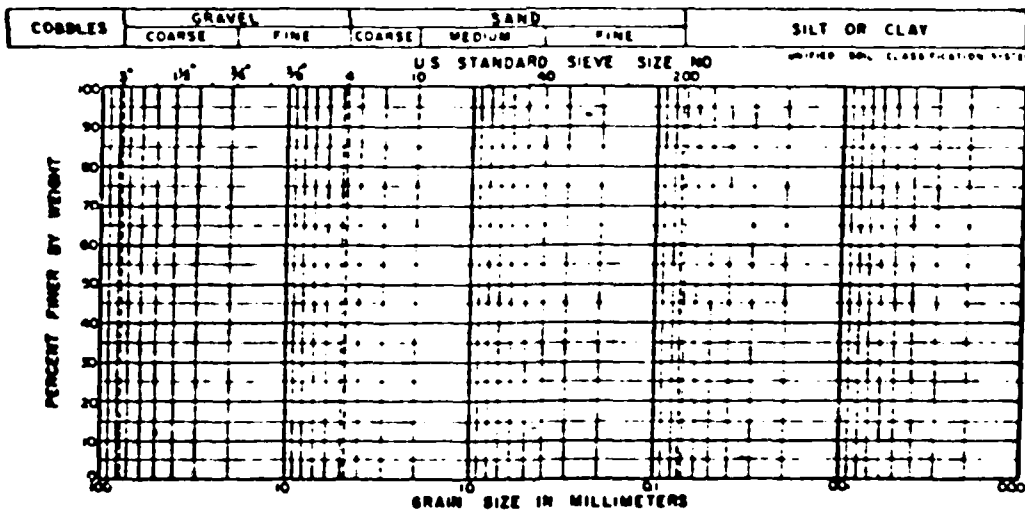


BORING	SAMPLE	DEPTH	SYMBOL	CLASSIFICATION	MC	LL	PL
2	1	6.7'-7.5'	○	Silty gravelly coarse to fine sand			

MECHANICAL ANALYSIS



BORING	SAMPLE	DEPTH	SYMBOL	CLASSIFICATION	MC	LL	PL
TP-A	2	6'	○	Silty sandy gravel			
TP-C	7	3.0'-4.0'	△	Sandy gravel with trace silt			
TP-L-2		8'	○	Gravelly sandy slightly clayey silt	15	21	16



BORING	SAMPLE	DEPTH	SYMBOL	CLASSIFICATION	MC	LL	PL

DESIGN REPORT

RECEIVED

N.J. - 625-R

AG 16 63

Earthfill Dam
on Branch of Big Flat BrookDEPT. CONC. & ECON. DEV.
DIVISION OF
WATER POLICY AND SUPPLY

Linwood

Newark YM-YWCA Family and Senior Citizens Camp

Sandyston Township
Sussex County, New JerseyLocation

The site is on a branch of Big Flat Brook at a point approximately 2,300 ft. upstream from the U.S. Route 206 bridge across this stream. A site location map is shown on Page 2 of the drawings.

Hydrology

The drainage area upstream from the structure consists of 1.05 square miles of woodland and meadow. A study of the runoff producing characteristics of the watershed was conducted following methods outlined in SCS Engineering Handbook Section 4, Hydrology-Supplement A. This study consisted of a survey and analysis of the drainage area in which the following were considered: soil infiltration and permeability, land use, and vegetative cover. An estimate of the Time of Concentration was based on the topography of the watershed and physical characteristics of the stream channel. Rainfall data was obtained from U.S. Weather Bureau Technical Paper No. 40 and a six-hour Point Rainfall Map developed by the U. S. Soil Conservation Service, based on records of maximum rainfalls. It was estimated that a storm duration of approximately 6 hours would be most critical for this watershed. Hydrographs were prepared which reflect the net effect of the combination of factors determining the amount and time distribution of runoff from the watershed resulting from the design storms. Following is a summary of the hydrologic criteria on which the design of the structure is based:

1. A 25 yr.-6 hr. storm will pass through the Reinforced Concrete Drop Inlet Spillway (closed conduit spillway,) without any discharge through an Emergency Spillway. This design storm represents 4.1 inches of rainfall. Dwy 4A
2. The basis for the Emergency Spillway channel design is a 100 yr.-6 hr. rainfall. This represents 5.1 inches of rainfall. The frequency of use of the Emergency Spillway was estimated at once in 25 years. Dwy 4B

REFERENCE:

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Box 670
New Brunswick, New Jersey

DRAWING NO.

N.J. - 625-R

SHEET 1 OF 2

DATE 8/16/63

DESIGN REPORT

5. The top of dam elevation was set so that a max. 6-hr. point rainfall would pass through the spillway without overtopping the dam. This represents 10.2 inches of rainfall. 247
46

The storm hydrographs were routed to determine elevations of the emergency spillway crest (levee section elevation,) design high water, and top of dam.

Hydraulics of Spillway

The principal spillway consists of a reinforced concrete drop inlet connected to a 54 inch diameter corrugated pipe. This type of spillway is also referred to as a closed conduit spillway. The pipe material will be 12 gage galvanized steel having an asbestos bonded bituminous coating. The stage discharge characteristics of the spillway were based on the results of model studies of similar structures at the St. Anthony Falls Hydraulic Laboratory, University of Minnesota, Minneapolis, Minnesota. This research is reported in Technical Paper No. 12, Series B, prepared by the U. S. Department of Agriculture, Agricultural Research Service, Soil and Water Conservation Research Division. A concrete slab on top of the concrete riser is necessary to prevent the formation of vortices, which would reduce the capacity of the spillway. The height of the slab above the riser crest was calculated (based on results of model studies) so that the anti-vortex device will have no other effect on the hydraulic characteristics of the spillway.

The Emergency Spillway is an open channel, trapezoidal in cross-section, having a bottom width of 120 feet and 2:1 side slopes. It will be excavated on the west side of the dam and will be a source of material for the earth fill embankments. The hydraulic design of the spillway is based on a method outlined in Technical Release No. 2, U. S. Soil Conservation Service. Essentially, the emergency spillway consists of an inlet channel, control section, and exit channel. Flow through the inlet channel is subcritical. At the control section the flow passes through critical depth, following which supercritical flow exists in the exit channel. The slope of the exit channel (below the control section) is set at greater than critical slope for all significant flows. Thus, supercritical flow is insured in the exit channel, and the stage-discharge relationship is determined at the assumed control section. The spillway was dimensioned so that the flow velocity would not exceed 4 feet per second for the design 100 yr.-6 hr. storm. This velocity could be tolerated for durations considerably in excess of those anticipated, with fair vegetative cover on the spillway.

REFERENCE:

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Box 670
New Brunswick, New Jersey

DRAWING NO.

M. J. - 625-R

SHEET 2 OF 3

DATE 8/16/63

DESIGN REPORT

Subsurface Investigation and Embankment Design

The subsurface investigation was conducted jointly by the U. S. Soil Conservation Service and Woodward-Clyde-Sherard and Associates, Soil and Foundation Consulting Engineers, 1425 Broad Street, Clifton, New Jersey. ✓

The embankment was designed by Woodward-Clyde-Sherard and Associates. Both of these subjects are reported by this firm under separate cover. ✓

Design Summary

Factor Which Determines Stage	Rainfall Inches	Runoff Inches	Peak Inflow cfs	Maximum Stage Feet	Flood Storage Ac.Ft.	Element of Structure Determined by Max. Stage
Normal Pool	-	-	-	110.0	0	Crest of Riser
25 yr.-6 hr. Storm	4.10	1.60	590	112.7	31.1	Crest of Emergency Spillway
100 yr.-6 hr. Storm	5.10	2.36	815	113.5	42.7	Design High Water
6 hr. Point Rainfall	10.20	6.80	2460	115.9	78.0	Top of Dam

NOTE: Assumed elevation datum.

PREPARED BY:

Robert M. Fox, P.E.
Robert M. Fox, P.E.
Design Engineer

REFERENCE:

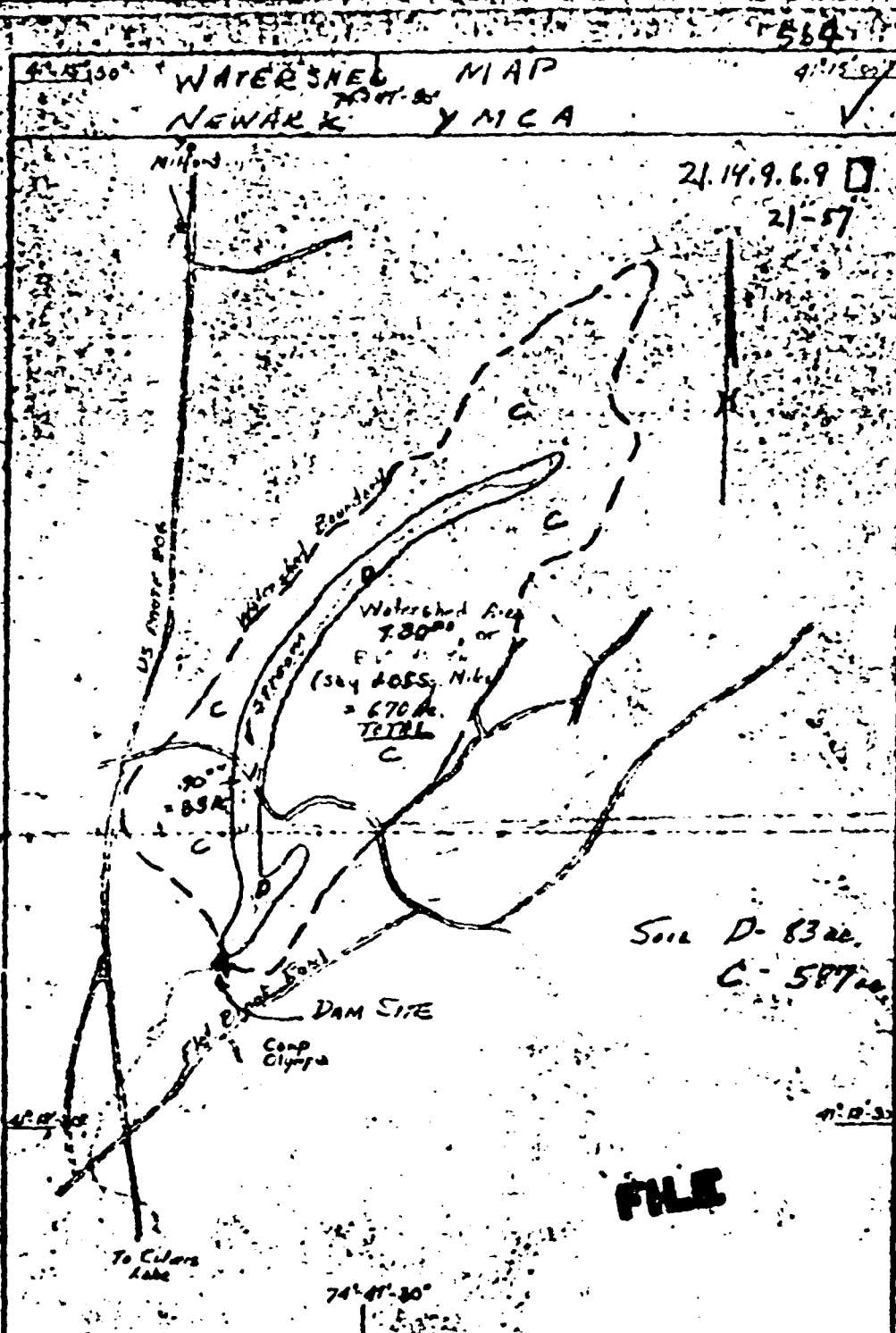
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Box 670
New Brunswick, New Jersey

DRAWING NO.

M. J. - 625-R

SHEET 3 OF 3

DATE 8/16/63



<p>REFERENCE: US DZ GEOLOGICAL SURVEY 11 24000 CUYAHOE GAP QUAD. HANGLE - 113 P. 1111</p>	<p>U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE ASSISTING SUPERVISOR CAMP L. 1111</p>	<p>DRAWING NO. N3825 NEWARK YMCA CAMP C 1111 SHEET L 1111 DATE 8-25-61</p>
---	---	--

New Jersey YMCA Dam

Elm. 612.5 N. 625

Design Criteria Summary

1. Normal Pool Elev. 110'

2. Route 25yr. inflow hydrograph

4A Through Mach Spillway to establish
crest stage of Emergency Spillway

3. Route 100yr. inflow hydrograph

4B Through Mach Spillway and Emerg.
Spillway to establish stage Elev.
for design high water

4. Route hydrograph developed

4C from 100% of point rainfall to

establish the min. elev. for the
top of the dam.

HYDROGRAPH COMPUTATION

6-25-64
6-18-64

WATERSHED OR PROJECT YMCA DAM STATE NJ

STRUCTURE SIZE OR SURFACE 545241 Co

DR. AREA 1.05 SQ. MI. 0.07 MI.

RUNOFF CURVE NO. 73 STORM DISTRIB. CURVE B HYDROGRAPH FAMILY NO. 3

STORM DURATION 6 HR. RAINFALL 1.5 IN. POINT 4.1 IN. AREA 4.1 MI.

0.16 MI. (0.7) 0.71 COMPUTED T. 0.49 MI. T. 0.42 MI.

(T. 8.9) COMPUTED 8.6 USED 10 REVISED T. 0.42

$Q = \frac{424 A}{REV. T.} = \frac{424 \times 1.05}{0.42} = 1070$ CFS $Q_p = 1270$ CFS

RECUAN: = (REV. T.) REV. T. COLUMB: = 6.0 CFS

LINE NO.	T. HOURS	Q CFS	LINE NO.	T. HOURS	Q CFS	LINE NO.	T. HOURS	Q CFS
1	0	0	21	4.54	107	41		
2	0.23	2	22	4.76	58	42		
3	0.45	16	23	4.99	23	43		
4	0.68	134	24	5.22	12	44		
5	0.91	495	25	5.44	8	45		
6	1.13	588	26	5.67	4	46		
7	1.36	522	27	5.90	2	47		
8	1.57	433	28	6.12	0	48		
9	1.81	365	29			49		
10	2.04	307	30			50		
11	2.27	270	31			51		
12	2.50	237	32			52		
13	2.72	210	33			53		
14	2.95	188	34			54		
15	3.18	173	35			55		
16	3.40	157	36			56		
17	3.63	151	37			57		
18	3.86	141	38			58		
19	4.09	131	39			59		
20	4.31	146	40			60		

Use for Design high Water

Em Spry

HYDROGRAPH COMPUTATION

OK
2/24/63
8-9-63

WATERSHED OR PROJECT

YMCA - DAM

STATE

NY 625

PROPERTY OF

SUSSEX Co.

DE AREA

105

L. 0.7

RUNOFF CONDITION NO.

2

RUNOFF CURVE NO.

73

STORM DIST. CLIVE

B

HYDROGRAPH FACTOR NO.

3

STORM DURATION

6

BASE PERIOD

100 yr.

FORM

5.1

AREA

5.1

0.236

COMPUTED T₁

49

4.45

R₁ + R₂

COMPUTED

7.08

USED

10

REVISED T₁

4.45

Q = $\frac{484.6}{REV T_1}$ = 1142 CFSQ₀ = 2695 CFSQ₁ = 2974 CFSQ COLUMN = R₁ / T₁ REV T₁Q COLUMN = R₂ / T₂ REV T₂

LINE NO.	1 HOURS	Q CFS	LINE NO.	1 HOURS	Q CFS	LINE NO.	1 HOURS	Q CFS
1	0.03	0	21	4.776	148	41		
2	0.240	3	22	5.046	51	42		
3	0.431	22	23	5.287	32	43		
4	0.711	126	24	5.527	16	44		
5	0.961	123	25	5.767	11	45		
6	1.202	87	26	6.005	5	46		
7	1.442	72	27	6.244	3	47		
8	1.682	60	28	6.483	0	48		
9	1.922	57	29			49		
10	2.163	48	30			50		
11	2.403	41	31			51		
12	2.643	32	32			52		
13	2.884	27	33			53		
14	3.124	24	34			54		
15	3.364	20	35			55		
16	3.605	17	36			56		
17	3.845	10	37			57		
18	4.085	8	38			58		
19	4.325	2.6	39			59		
20	4.566	2.0	40			60		

Frazer's Canyon
about 1000 ft. Fall

STATE NJ 225

RECEIVED 105

1.0.7

RUNOFF CONDITION NO.

STORM DISTURBANCE

B

HYDROGRAPH 2 AND 1 NO

STOCK DURATION 6 mo

100-101 (101) 101

Page 102.

10.2-

6.8

COMPUTED L. 2.49 mi

5.05

1542

COMPUTED 8.81

used 10

REVISED 1. 0.51

$$C = \frac{484 \text{ A}}{\text{REV. L}} = \underline{996} \text{ cps}$$

6770

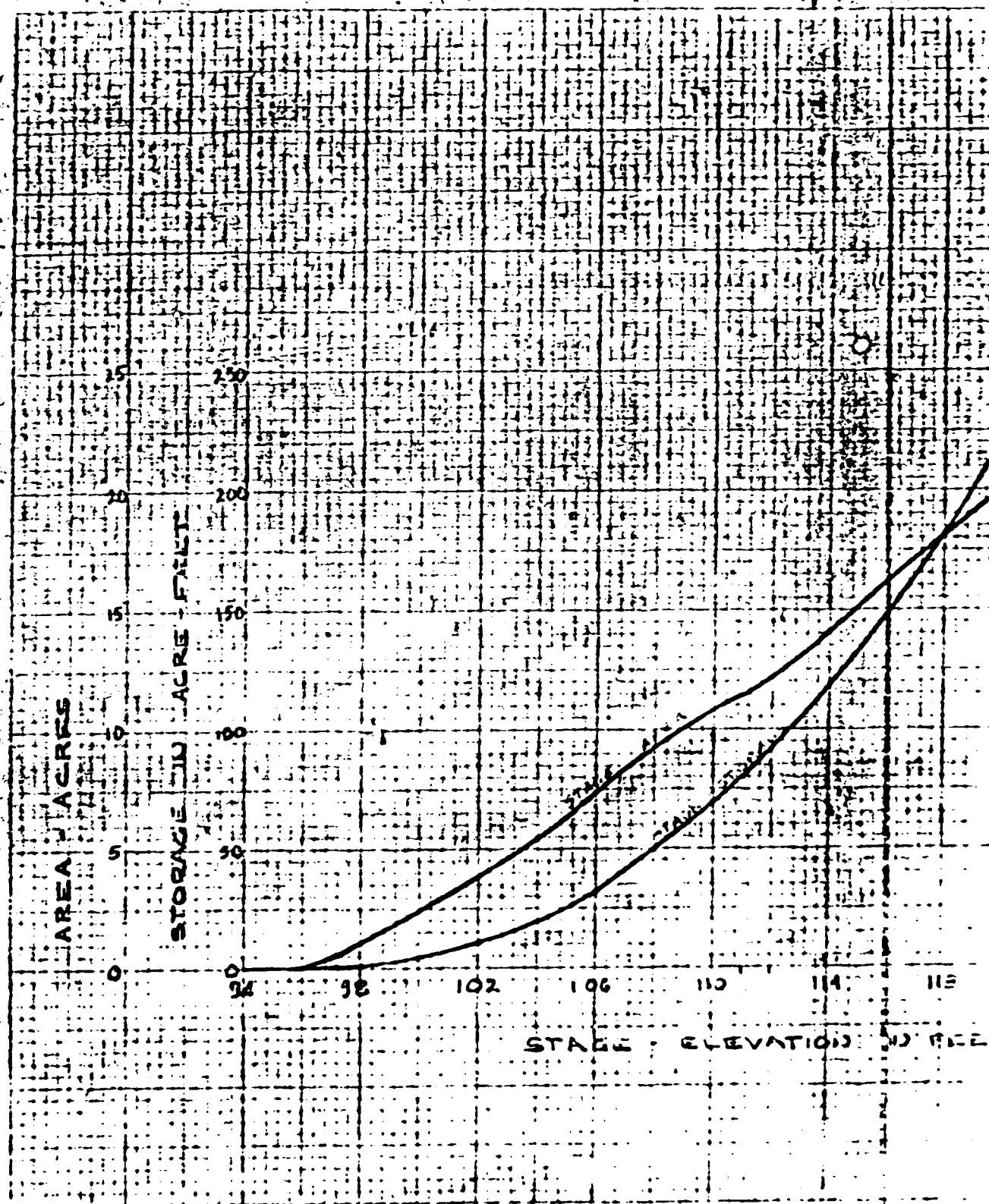
on 2444

(COLUMN, = R T.) REV. 2.

COLLEGE - 10 11 12

RF 41

LINE NO.	1 HOURS	2 CFS	LINE NO.	1 HOURS	2 CFS	LINE NO.	1 HOURS	2 CFS
1	0	0	21	6.43	27	41		
2	1.32	14	22	6.15	14	42		
3	0.64	61	23	7.07	7	43		
4	0.96	103	24	7.37	0	44		
5	1.29	427	25			45		
6	1.61	1575	26			46		
7	1.93	2464	27			47		
8	2.25	2078	28			48		
9	2.57	1530	29			49		
10	2.89	1164	30			50		
11	3.21	921	31			51		
12	3.53	765	32			52		
13	3.86	657	33			53		
14	4.18	576	34			54		
15	4.50	528	35			55		
16	4.82	501	36			56		
17	5.14	467	37			57		
18	5.46	357	38			58		
19	5.78	161	39			59		
20	6.10	31	40			60		



SHEET

NT 625
AA JUMINS

1-63

118
SHEET

AVAILABLE STORAGE
STAGE STORAGE 4
STAGE AREA CURVES
NEWARK YMCA CLUB
INDEX CO. 111, 112, 113, 114

NJ 623

3-25-63

Weir Flow - Discharge Curve Comp. JLA

22 115 C. 3.4 CL = 74.8

Elev	H _w (ft)	H _x	Q _w
110.0	0.0	0.00	0.00
110.2	0.2	0.059	6.69
110.5	0.5	0.354	26.48
110.7	0.7	0.596	41.83
111.0	1.0	1.000	74.50
111.5	1.5	1.537	137.41
112.0	2.0	2.273	211.53
112.5	2.5	3.253	295.69
113.0	3.0	5.196	389.64
113.5	3.5	6.549	489.79
14.0	4.0	5.000	599.40

Sumner Co. N.J. 3-25-62

Pipe Discharge - Discharge Curve Comp. J.A.

$K_p = 0.0036$
 $n = 0.022$
 $C_p = 63.8 \text{ (SA-CMP)}$

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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Sheet 1 of 1

AREA OF CONTAINERS FOR STA. 1-50-A-11, AREA CIV. 25, NJ 625

NEWARK YNICH CAN. - SUSSEX COUNTY

AA JLM:WJS

1-63

10' x 3600' = 0.0826 AC

STAGE (FT.)	PLANIMETER READING			AVE. READING (IN)	AREA (AC)	AVE. AREA (AC)	VOLUME (AC-FT)	VOLUME (AC-FT)
①	②	③	④	⑤	⑥	⑦	⑧	⑨
04.5	0	0	0	0	0	0	0	0
						0.002	0.002	
95	11	11	11	11	0.01	0.01	0.01	0.003
						0.45	0.45	
06	1.02	1.02	1.02	1.02	0.03	0.03	0.03	0.048
						0.55	0.55	
07	5.15	5.15	5.15	5.15	0.43	0.43	0.43	0.313
						0.72	0.72	
08	12.24	12.24	12.24	12.24	1.01	1.01	1.01	1.025
						1.16	1.16	
100	23.17	23.17	23.17	23.17	2.27	2.27	2.27	4.280
						3.02	3.02	
100	45.60	45.60	45.60	45.60	3.772	3.772	3.772	10.450
						4.54	4.54	
104	64.72	64.72	64.72	64.72	5.55	5.55	5.55	13.950
						6.21	6.21	
06	35.2	35.2	35.2	35.2	7.37	7.37	7.37	32.260
						8.20	8.20	
107	112.71	112.71	112.71	112.71	3.144	3.144	3.144	45.17
						1.237	1.237	
110	132.07	132.07	132.07	132.07	11.752	11.752	11.752	68.002
						11.45	11.45	
111	147.96	147.96	147.96	147.96	12.005	12.005	12.005	31.27
						13.10	13.10	
	172.22	172.22	172.22	172.22	14.115	14.115	14.115	12.150
						14.25	14.25	
11	186.71	186.71	186.71	186.71	16.213	16.213	16.213	142.11

57-54 05

Newark YMCA Camp NJ 625

Senior Const. M. J. 3-26-63

STAGE STORAGE COMPUTATION:

145

[illegible]

Enclosure 3: Bill of Sale of land - 1908

[illegible]

Expenditure Statement

[illegible]

N. 625

نہجہ

[illegible]

1. AGRICULTURAL PRODUCTION

8/21/6

Da-564

Embankment Stability

1. Core and foundation material
Plastic, clayey material

(estimated)

$$\begin{aligned} \text{Cohesion, } c &= 100 \text{ pcf} \\ \phi &= 25^\circ \\ \gamma &= 130 \text{ lb/ft}^3 \text{ saturated} \\ \gamma &= 90 \text{ lb/ft}^3 \text{ dry} \end{aligned}$$

2. Random Material

(estimated)

$$\begin{aligned} \text{Cohesionless, } c &= 0 \\ \phi &= 30^\circ \\ \gamma &= 140 \text{ lb/ft}^3 \text{ saturated} \\ \gamma &= 110 \text{ lb/ft}^3 \text{ dry} \end{aligned}$$

For solution, see Dupical Analysis

$$\text{Circle arc length} = \frac{37}{360} \times 326.73 = 179.2 \text{ ft}$$

N-Fracs

$$\text{Random Mat. } 302 \text{ sq ft} \times 140 = 42400$$

$$30 \times 110 = 3300$$

$$\text{Core Mat. } 491 \times 130 = 62500$$

$$63 \times 90 = 5670$$

$$\Sigma \text{ N-Fracs} = 113870 \text{ lbs}$$

8/21/13

Stability, continued

T- Forces

Negative: Random Met. = $15 \text{ sp. ft} \times 140 = 2100$

Core Met. = $45 \times 130 = 5850$

Total Pos. T-Force = 7950 lb

Positive Random Met. = $88.5 \times 140 = 12390$

$15 \times 110 = 1650$

Core Met. = $129 \times 130 = 16770$

$63 \times 90 = 5670$

Total Neg. T-Force = 32280

$\Sigma T \text{ Force} = 32280 - 7950 = 24330$

$\tan \theta = \tan 25^\circ = 0.4663$

Cohesion = $L_c = 179 \times 100 = 17900$

F.S. = $\frac{\Sigma N \tan \phi + L_c}{\Sigma T} = \frac{113870 + 17900}{24330}$

F.S. = $\frac{71400}{24330} = \underline{\underline{2.93}}$

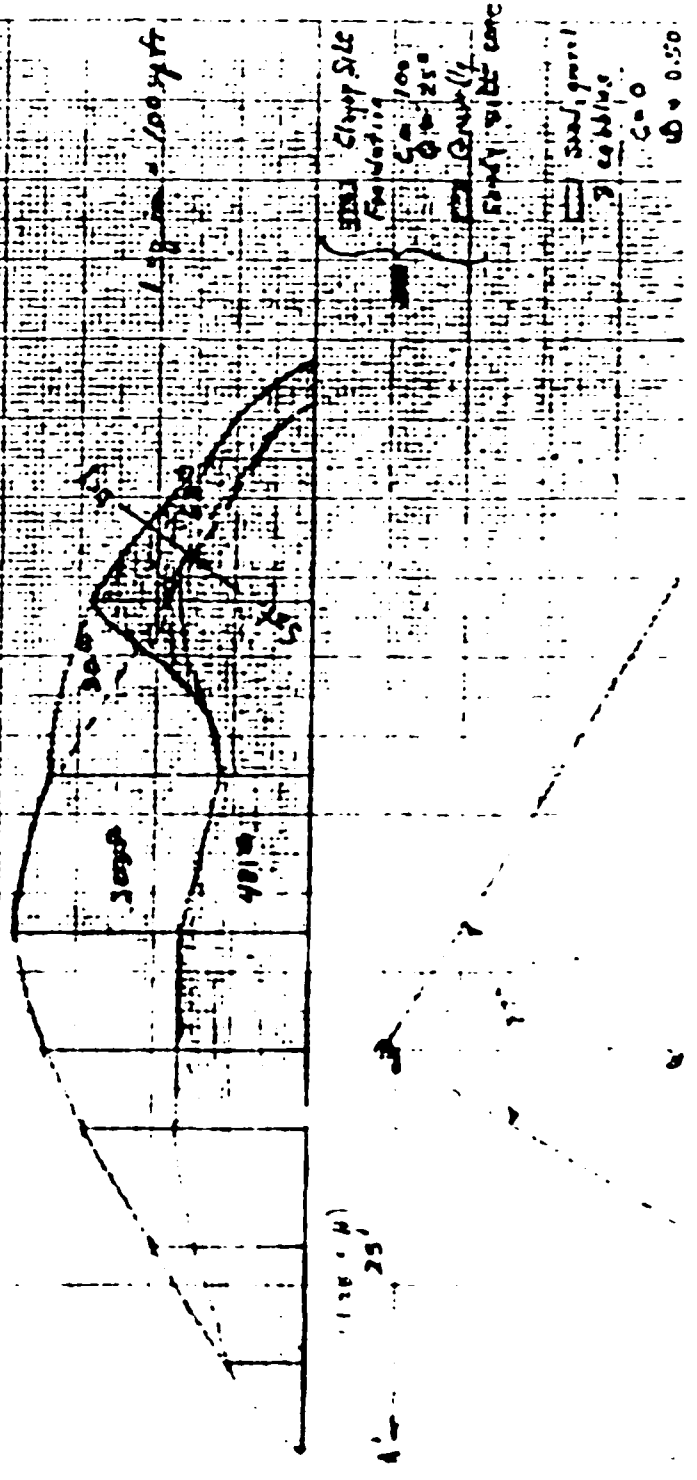
OK.

DAN 564 Newark YM-YWCA

GRAVITY ANALYSIS

Embankment stability

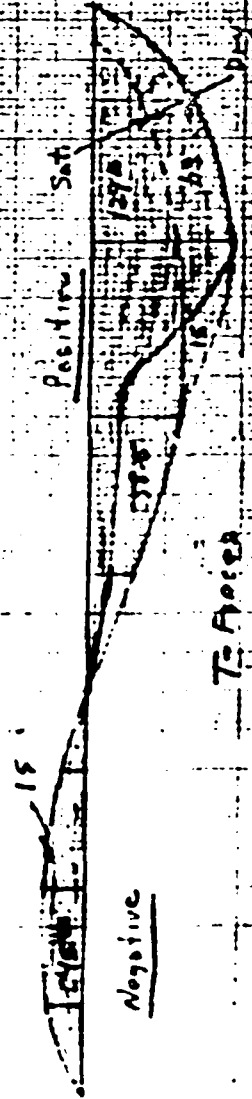
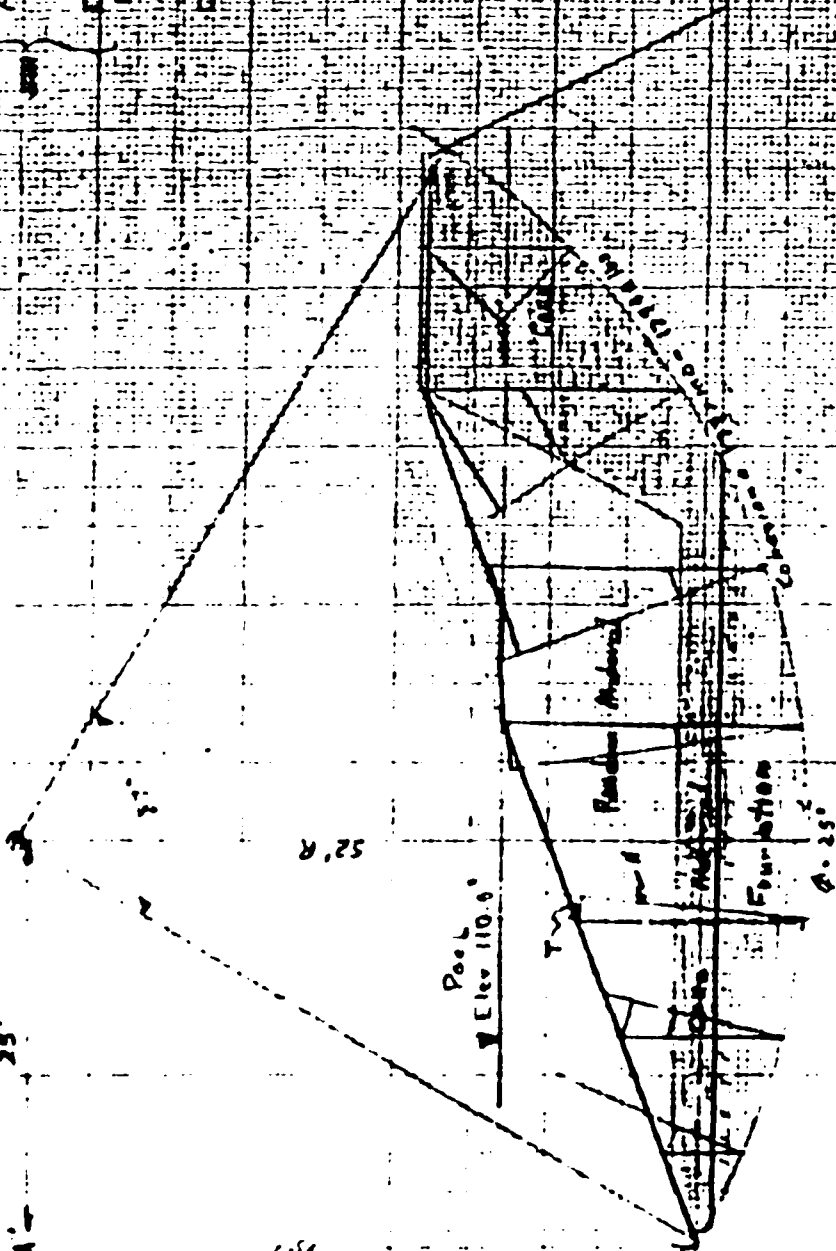
N- Forces



125' (H)
25'

FEET Clay
Foundation
C = 100
Q = 250
Gravelly
Sand, silty conc

Steel gravel
C = 0
Q = 0.50



Negative

To Forces

310

H
2601

Report on Dam Inspection

NEWARK YMCA DAM
DAM APPLICATION NO. 564

Inspection was made of the subject dam site in company with Victor Elias, on October 2, 1963. Inspection disclosed that the lake site has been partially cleared and the site of the dam has been stripped to a layer of heavy sand clay except in two small areas, one of which was composed of heavy organic clay which appeared to be satisfactory, and the other section was composed of organic muck. Mr. Elias advised that more of the organic clay would be removed, but rather than go down completely to try and find better material and take the chance of completely stripping the clay blanket which is only approximately 3 feet thick and overlays a strata of sand and gravel, he felt it would be better to use the organic clay. He advised that the muck would be removed entirely and if necessary a clay blanket would be constructed in this area. A clay blanket will also be constructed in this area for a short distance upstream and downstream of the dam. A core wall is to be constructed into the existing earth embankment at the easterly end of the dam, since material here is not as what was expected. The emergency spillway section has been completely cleared but has not been graded. The work appeared to be progressing in a satisfactory manner.

John H. O'Leary
John H. O'Leary, P. E.
Supervising Engineer

Trenton, New Jersey
October 2, 1963

JOH:ax

00
DALLAS CALIFORNIA
SAN DIEGO CALIFORNIA

DENVER COLORADO
KANSAS CITY MISSOURI
PHILADELPHIA PENNSYLVANIA

00
OMAHA NEBRASKA
NEW YORK NEW YORK

WOODWARD-CLYDE-SHERARD AND ASSOCIATES

SOIL AND FOUNDATION ENGINEERING

425 BROAD STREET

CLIFTON, NEW JERSEY

TELEPHONE 471-2000

PRINCIPALS
JAMES L. SHERARD
DOUGLAS C. WOODHOUSE
DAVID H. GREER

ASSOCIATE
ROY E. HUNT

July 14, 1964
63X183

Newark YM-YWCA
600 Broad Street
Newark 2, New Jersey

Attention: Mr. Louis Briegel

RECEIVED

JUL 12 '67

DEPT. CIVIL & ECON. DEVL.
DIVISION OF
WATER POLICY AND RESEARCH

Final Report
Construction Inspection
Newark Y. M. C. A. Dam
Sandyston Township, New Jersey

Gentlemen:

Submitted herewith is our report describing the final phase of construction at the subject project. After the winter shut-down, work was resumed at the site on May 4, 1964, and was completed on June 10, 1964.

Our inspection indicates that the embankment was constructed to final design grades and in accordance with the specifications. Field density tests were taken periodically in the core section of the embankment to insure that the required compaction was attained, these tests are tabulated as follows:

<u>Test #</u>	<u>Location</u>	<u>Per cent Moisture</u>	<u>Unit Dry Weight pcf</u>	<u>Per cent of Compaction</u>
6	Sta. 1+50 El. 103	11.4	120	99
7	Sta. 2+00 El. 105	11.2	119	98
8	Sta. 2+50 El. 107	10.5	119	98
9	Sta. 4+00 El. 108	10.0	120	99
10	Sta. 4+50 El. 109	9.0	127	100-
11	Sta. 5+00 El. 111	12.5	115	96

Gradation curves for most of the above test samples are shown on the attached plate.


July 14, 1964


Earlier field density test results were presented in our interim report dated December 18, 1963.

Other phases of the project which were completed or carried out satisfactorily during this period included: completion of the drop-inlet spillway riser; final grading of the emergency spillway; grading of the main borrow area and spreading of topsoil over this area; and construction of 2:1 slopes around the upper end of the lake between Elev. 107 and 110. In addition, a layer of impervious core-type material about one-foot thick was placed over exposed gravelly areas at about Elev. 107 in the upper end of the lake, in accordance with our recommendations.

We have enjoyed working with you on this project. Please call us if we can be of further service.

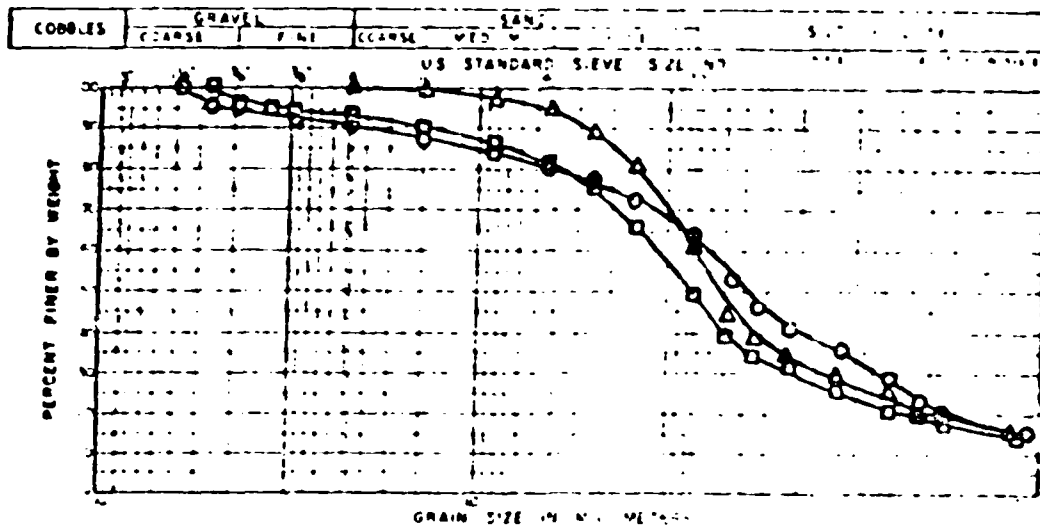
Very truly yours,


Herbert L. Lobbell, P. E.

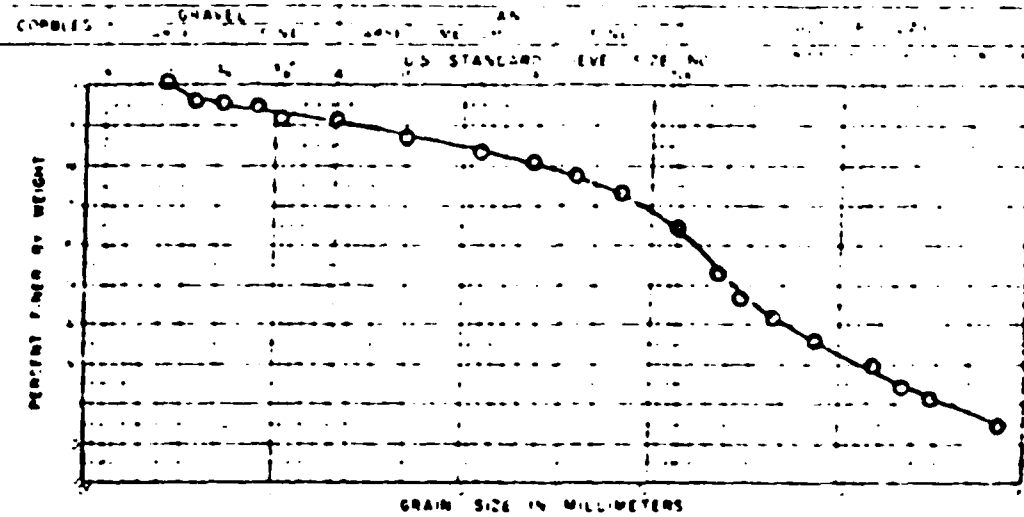

David M. Greer, P. E.

HLI:ed
Submitted: 5 copies

GRAIN-SIZE DISTRIBUTION



BORING	SAMPLE	DEPTH	SYMBOL	CLASSIFICATION	W _L	W _P	U _C
	8	Type #1	○	Slightly gravelly sandy clayey silt			
	9	Type #1	△	Sandy clayey silt			
	10	Type #1	□	Slightly gravelly sandy clayey silt			



BORING	SAMPLE	DEPTH	SYMBOL	CLASSIFICATION	W _L	W _P	U _C
	11	Type #1	○	Slightly gravelly sandy clayey silt			



of Newark and Vicinity
600 Broad Street,
Newark, N.J.
MA 4-8900

Camping Services

CAMP DAWSON

boys and girls day camp

LINWOOD

retreat center
for families and senior citizens

KAMP KIAMESHA

boys resident camp

CAMP MACDONALD

girls resident camp

RECEIVED

January 11, 1967

JAN 12 '67

DEPT. OF CONSERVATION
DIVISION OF
WATER POLICY AND SUPPLY

Mr. George R. Shanklin
Chief, Engineer and Director
Division of Water Policy and Supply
Department of Conservation and Economic Development
P.O. Box 1390
Trenton
New Jersey 08625

Re: Dam Application #564

Dear Mr. Shanklin:

When I talked with you on the phone yesterday I'm sure you realized that your letter of January 9, 1967 was quite a shocker.

We now find that your letter of July 20, 1966 was received by Louis R. Briegel, our Camping Services Director who forwarded it to Woodward-Clyde-Sherard and Associates, Clifton, New Jersey. We assumed that a copy of the final report of the engineers had been sent to you.

Enclosed you will find a copy of this Final Report, Construction Inspection dated July 14, 1964 signed by the resident and supervising engineers,

I can personally certify that from personal visits before, during and after construction that construction was carried out in line with specifications. I can further certify that a licensed engineer was in residence during the entire working hours to run moisture and compaction tests and laying and knitting of each 4 inches of clay.

Mr. G. R. Shanklin
re: Dam Application #564

- 2 -

If the information which we have enclosed is not sufficient we will be pleased to comply with your requests.

Incidentally, members of the United States Department of Agriculture Soil Conservation Service, Trenton, New Jersey were very much interested with the project from the initial steps and followed the work to completion. They were extremely well pleased. The principals involved were Richard H. Marston and Robert H. Fox.

Sincerely yours,



Joseph H. Partenheimer
Vice President
YM-YWCA of Newark and Vicinity

P. S. Enclosed you will find a dedication folder naming the lake "Lake Robert Rooke". We would appreciate your naming it as such on all official maps. ✓

JHP:mr
Encls.

APPENDIX 2

CHECK LIST - HYDROLOGIC AND HYDRAULIC DATA

CHECK LIST - VISUAL INSPECTION

CHECK LIST - ENGINEERING DATA

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 1.05 sq. mi., Wood & Forest Land

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 110.0 (69 ac ft)

ELEVATION TOP OF DAM

(STORAGE CAPACITY): 115.9 (147 ac ft) Assumes top of Dam

ELEVATION EMERGENCY SPILLWAY CREST 112.7

ELEVATION TOP DAM: 115.9

CREST: Drop inlet Spillway (Principal Spillway)

- a. Elevation 110.0
- b. Type drop inlet spillway, 4 1/2 x 6 1/2 ft riser to 54 in. dia CMP discharge pipe
- c. Width NA
- d. Length NA
- e. Location Spillover Approx 170 ft left of right dam abutment
- f. Number and Type of Gates None

OUTLET WORKS:

- a. Type 16 in dia. CIP low level outlet discharging into spillway riser
- b. Location in drop inlet spillway
- c. Entrance inverts 97.0
- d. Exit inverts El 97.0 into spillway riser, El 93.0 at spillway discharge
- e. Emergency draindown facilities Same

HYDROMETEOROLOGICAL GAGES: None

- a. Type _____
- b. Location _____
- c. Records _____

MAXIMUM NON-DAMAGING DISCHARGE: 2093 cfs at top of dam

Emergency Spillway:

Type: Earth, broad crested weir
Crest Elevation: 112.7
Width: 120 ft
Crest Length: 20 ft
Location: Approx 100 ft west of right dam abutment.

AD-A100 407

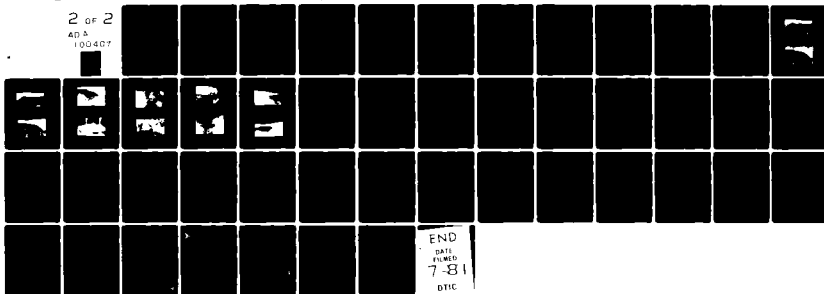
NEW JERSEY DEPT OF ENVIRONMENTAL PROTECTION TRENTON F/6 13/13
NATIONAL DAM SAFETY PROGRAM. LAKE ROBERT ROOKE DAM (NJ00262), 0--ETC(U)
MAR 81 P K YU DACW61-79-C-0011

UNCLASSIFIED

DAEN/NAP-53842/NJ00262-81/ NL

2 of 2

ADA
100407



Check List
Visual Inspection
Phase 1

Name Dam Lake Robert Rooke Dam County Sussex State NJ Coordinators NJ DEP

Date(s) Inspection 9/26/80 Weather Clear Temperature Mid 70's ° F
12/11/80 Arbitrary Datum
 Pool Elevation at Time of Inspection 109.4⁺ MSL Tailwater at Time of Inspection 93.7 MSL

Inspection Personnel:

R. W. Greene P. Yu D. Leary
 V. Urban _____

 R. W. Greene _____ Recorder

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	NONE OBSERVED.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	NONE OBSERVED.	
SLOUCHING OR EROSION OF EMBANKMENT AND ADJUTANT SLOPES	MINOR EROSION OF EMBANKMENTS CAUSED BY NUMEROUS FOOTPATHS. EROSION ALONG UPSTREAM EMBANKMENT AT POOL ELEVATION.	REPAIR AREAS OF EROSION.
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	NO APPARENT DEFICIENCY OBSERVED.	
RIPRAP FAILURES	NO RIPRAP OBSERVED.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
	EMBANKMENTS BECOMING OVERGROWN WITH BRUSH AND TREES.	REMOVE TREES, PROVIDE FILTER COVERAGE ON DOWNSTREAM FACE TO PREVENT ANY SEEPAGE RESULTING FROM FUTURE ROOT DECAY.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	NO APPARENT DEFICIENCY OBSERVED.	
ANY NOTICEABLE SEEPAGE	NONE APPARENTLY OBSERVED, LOCALIZED SPONGY GROUND AT DOWNSTREAM TOE NEAR CENTER LINE OF DAM.	FURTHER INVESTIGATE CONDITION.
STAFF GAGE AND RECORDER	NONE OBSERVED.	
DRAINS	NONE VISIBLE.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	NO APPARENT DEFICIENCY OBSERVED.	OUTLET CONDUIT IS A 54 IN DIA CMP.
INTAKE STRUCTURE	CONCRETE DROP INLET HAS ACCUMULATION OF BRANCHES AROUND TOP OF INLET. THE RISER HAS NUMEROUS BRANCHES IN IT. NO DEFICIENCY OBSERVED ON CONCRETE.	REMOVE BRANCHES FROM RISER AND INLET. INSTALL TRASH SCREENS TO PREVENT REOCCURANCE.
OUTLET STRUCTURE	NO APPARENT DEFICIENCY OBSERVED.	
OUTLET CHANNEL	WIDE STREAMBED WITH GRASS & BRUSH. SMALL COBBLE DAM APPROX 1 FT HIGH ACROSS STREAMBED.	REMOVE COBBLE DAM.
EMERGENCY GATE	16 IN DIA CI LOW LEVEL OUTLET WITH SLIDE GATE IN UPSTREAM SIDE OF DROP INLET RISER. APPROX. 12 FT BELOW TOP OF INLET. SLIDE GATE LEAKING WATER.	REPAIR SLIDE GATE

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	ROUGHLY 4H:1V TREES & BRUSH COVERED.	
SEDIMENTATION	VERY LITTLE OBSERVED.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	WIDE STREAM BED WITH SMALL COBBLE DAM APPROX 1 FT HIGH ACROSS STREAMBED ABOUT 30 FT DOWNSTREAM OF 54" CMP OUTLET. THICK TREES & BRUSH ALONG STREAMBED. NO RIPRAP OBSERVED AT 54" CMP DISCHARGE.	REMOVE COBBLE DAM. CLEAR CHANNEL.
SLOPES	GENTLE, DENSELY VEGETATED WITH TREES AND BRUSH.	
APPROXIMATE NO. OF HOMES AND POPULATION	NONE OBSERVED.	

CHECK LIST
-ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM DAM SITE & LAKE AREA NEWARK YMCA DAM SANDYSTON TOWNSHIP SUSSEX CO., NEW JERSEY	PREPARED BY: US DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE DRAWING NO. NJ 625-P, SHEET 2 OF 4, 1963
REGIONAL VICINITY MAP. SEE FIGURE 1	
CONSTRUCTION HISTORY	NO INFORMATION AVAILABLE
TYPICAL SECTIONS OF DAM	EMBANKMENT PLANS & PROFILE NEWARK YMCA DAM SANDYSTON TOWNSHIP SUSSEX COUNTY, NEW JERSEY PREPARED BY: US DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE DRAWING NJ 625-P, SHEET 3 OF 4, 1963
HYDROLOGIC/HYDRAULIC DATA	LETTER FROM: US DEPT OF AGRICULTURE, SOIL CONSERVATION SERVICE, BOX 670 NEW BRUNSWICK, N.J. Source: NJ DEP Application 564 MR. RICHARD H. MARSTON DATED June 27, 1963 MEMORANDUM TO: ROBERT L. HARDMAN, CHIEF, BUREAU OF WATER CONTROL FROM RAYMOND A. WEBSTER, DATE June 28, 1963, Source: NJ DEP Application 564 DESIGN REPORT NJ625- BY US DEPT OF AGRIC. SOIL CONSERVATION SERVICE, BOX 670 NEW BRUNSWICK, NJ 8/16/63
OUTLETS - PLAN	
- DETAILS CONSTRUCTION DESIGN	STRUCTURE & STEEL DETAIL NEWARK YMCA DAM SANDYSTON TOWNSHIP SUSSEX COUNTY, NEW JERSEY PREPARED BY: US DEPT OF AGRIC. SOIL CONSERVATION SERVICE DRAWING NO NJ 625-P, SHEETS 3 OF 4, 4 OF 4, 1963
RAINFALL/RESERVOIR RECORDS	

ITEM	REMARKS	
DESIGN REPORTS	Subsurface Investigation and embankment design by Woodward-Clyde - Sherard Associates 1425 Broad Street, Clifton, New Jersey "Preliminary Report, Soil and Foundation Investigation and Design Newark YMCA Dam, Sandston Township, New Jersey" June 18, 1963	Source: NJ DEP Application No. 564
GEOLOGY REPORTS	See Design Reports	
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Design Report NJ 625-R US Department of Agriculture Soil Conservation Service Box 760 New Brunswick, NJ Dated 8/16/80	Source: NJ DEP Application NO. 564
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	See <u>Design Reports</u>	
POST-CONSTRUCTION SURVEYS OF DAM	Report by: Woodward Clyde Sherard & Associates 1425 Broad Street, Clifton, New Jers <u>Final Report, Construction Inspection Newark YMCA Dam, Sandyston Township, New Jersey</u> dated July 14, 1964	
BORROW SOURCES.	Indicated on Plan, Damsite & Lake Area, Newark YMCA Dam Sandyston Township, Sussex County New Jersey	Source: NJ DEP Application 564
	Prepared by: US Department of Agriculture Soil Conservation Service Drawing NO. NJ 625-P Sheet 2 of 4, 1963	
	And Preliminary Report given under <u>Design Reports</u>	

ITEM REMARKS

MONITORING SYSTEMS NONE OBSERVED

MODIFICATIONS NONE OBSERVED

HIGH POOL RECORDS NO INFORMATION AVAILABLE

POST CONSTRUCTION ENGINEERING Report By: Woodward-Clyde-Sherard & Associates July 18, 1967
 STUDIES AND REPORTS Arnold R. Smith, NJ PE 14857, November 11, 1968
 Charles H. Thanley, NJ PE 15594, September 4, 1970
 Charles H. Thanley, NJ PE 15594, August 28, 1971

Source: NJ DEP
 Application 564

PRIOR ACCIDENTS OR FAILURE OF DAM
 DESCRIPTION NONE REPORTED
 REPORTS

MAINTENANCE NO INFORMATION AVAILABLE
 OPERATION
 RECORDS

ITEM	REMARKS
SPILLWAY PLAN	Emergency Spillway Plan, Profiles
SECTIONS	Damsite & Lake Area Newark, YMCA Dam Sandston Township
DETAILS	Sussex County, New Jersey
OPERATING EQUIPMENT PLANS & DETAILS	16 inch Sluice Gate Shown on Structural & Steel Detail Newark YMCA Dam Sandyston Township Sussex County, New Jersey
	Prepared by: US Department of Agriculture Soil Conservation Service Drawing NO. NJ 625-P, Sheets 2 of 4 and 3 of 4, 1963
	Prepared by: US Department of Agriculture Soil Conservation Service Drawing NO. NJ 625 P Sheet 4 of 4, 1963

APPENDIX 3
PHOTOGRAPHS



Crest of dam looking from
left abutment towards right
abutment.

26 September 1980



Downstream embankment viewed from
center of dam looking towards left
abutment.

26 September 1980



Crest of dam looking from
left abutment towards right
abutment.

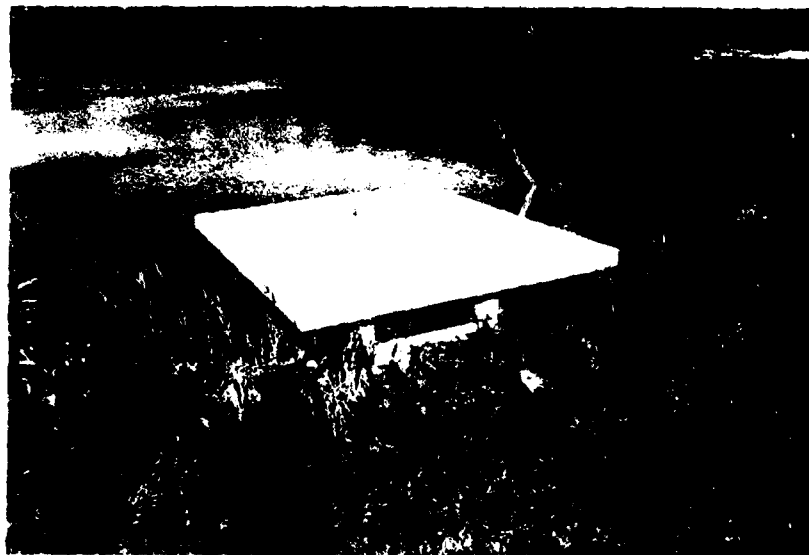
26 September 1980



Downstream embankment viewed from
center of dam looking towards left
abutment.

26 September 1980

LAKE ROBERT ROOKE DAM



Top of drop inlet spillway.

26 September 1980



Crest of drop inlet spillway.
Note: Accumulation of branches
and weeds.

26 September 1980

LAKE ROBERT ROOKE DAM



Erosion of downstream embankment. 26 September 1980



Drop inlet spillway discharge and channel viewed from top of dam. 26 September 1980



Approach channel of emergency
spillway.

26 September 1980



Discharge channel of emergency
spillway.

26 September 1980



West shore of reservoir viewed
from top of dam.

26 September 1980



East shore of reservoir viewed
from top of dam.

26 September 1980

APPENDIX 4
HYDROLOGICAL CALCULATIONS

HYDROLOGIC COMPUTATIONS

ROBERT ROOKE LAKE DAM

Location : Sussex County, N.J.

Drainage Area : 1.05 sq. mi (670 acrs)

Lake Area : 10.8 acres

Classification : Size — small
Hazard — high

Spillway Design Flood :

Based on available information, the dam was designed in 1963 to adequately pass a 6-hr Point Rainfall determined from U.S. Weather Bureau Technical Paper No. 40 and a six-hour Point Rainfall Map developed by the U.S. S.C.S. based on records of maximum rainfalls. This storm is equivalent to 10.2 inches of rainfall and has a peak inflow of 2460 cfs.

In accordance with the Corps of Engineers Screening Criteria, the SDF for dams of small size and high hazard is $\frac{1}{2}$ PMF to PMF. The PMF is chosen for the evaluation of this dam.

BY py DATE 3/24/81 Robert Rook Lake Dam JOB NO. 80145
CKD RUC DATE 3/27/81 SHEET NO. 1 OF 1

PMP

1. Dam located in Zone 1 (Near boundary to Zone 6)

PMP = 22.0 inches (for 200 sq. mi., 24 hr.
all season envelop)*

2. PMF must be adjusted by a factor of 0.8**
to account for the basin size being < 10 sq. mi.

% Factor (for 10 sq. mi)

<u>Duration, hrs</u>	<u>Zone 1</u>	<u>Zone 6</u>	<u>Avg</u>
0-6	111.	112	112
0-12	123	123	123
0-24	133	132	133
0-48	142	142	142

* HMR # 33

** pg. 48 "Design of Small Dam"

BY Ry
CKD RGG

DATE 3/24/81
DATE 3/27/81

Robert Rook Lake Dam.

JOB NO. 80145
SHEET NO. 2 OF

Time of Concentration, T_c

1. Based on the original design by SCS using velocity and length of course method, an estimated $T_c = 0.7$ hr.
2. Using the same data for the water course, i.e.

	Slope of course	Length of course
overland	7%	3000 ft
channel	3%	9000 ft

estimate T_c by curve number method (SCS TR 55)

$$\text{Average slope} = \left(\frac{7 \times 3000 + 3 \times 9000}{12000} \right) \% = 4\%$$

Take $CN = 73$, $L = 12000$ ft, slope = 4%

from TR 55, Fig. 3.3

$$L \approx 1.3 \text{ hr. or } T_c = \frac{1.3}{0.6} = 2.17 \text{ hr.}$$

$$\text{Use Avg } T_c = \frac{0.7 + 2.17}{2} = 1.43 \text{ hrs.}$$

$$\therefore \boxed{L = 0.6 T_c \approx 0.85 \text{ hr.}}$$

BY Dry DATE 3/21/01
CKD Rwb DATE 3/27/01

JOB NO. 80145
SHEET NO. 3 OF

POOL ELEV.	OUTFLOW OF DROP INLET CFS	OUT FLOW EMERGENCY SPILLWAY LE 120 FT		OUT FLOW OVER DAM LE 620 FT		TOTAL OUTFLOW EQ, cfs
		H, ft	C	H, ft	C	
110.0	0					0
111.0	75					75
112.0	212					212
112.7	262	0				262
113.0	265	0.3	2.69			318
113.5	269	0.8	2.64			496
114.0	272	1.3	2.64			742
115.0	280	2.3	2.63			1380
115.9	286	3.2	2.63	0		2093
116.0	287	3.3	2.63	0.1	2.68	2231
117.0	294	4.3	2.63	1.1	2.68	5025

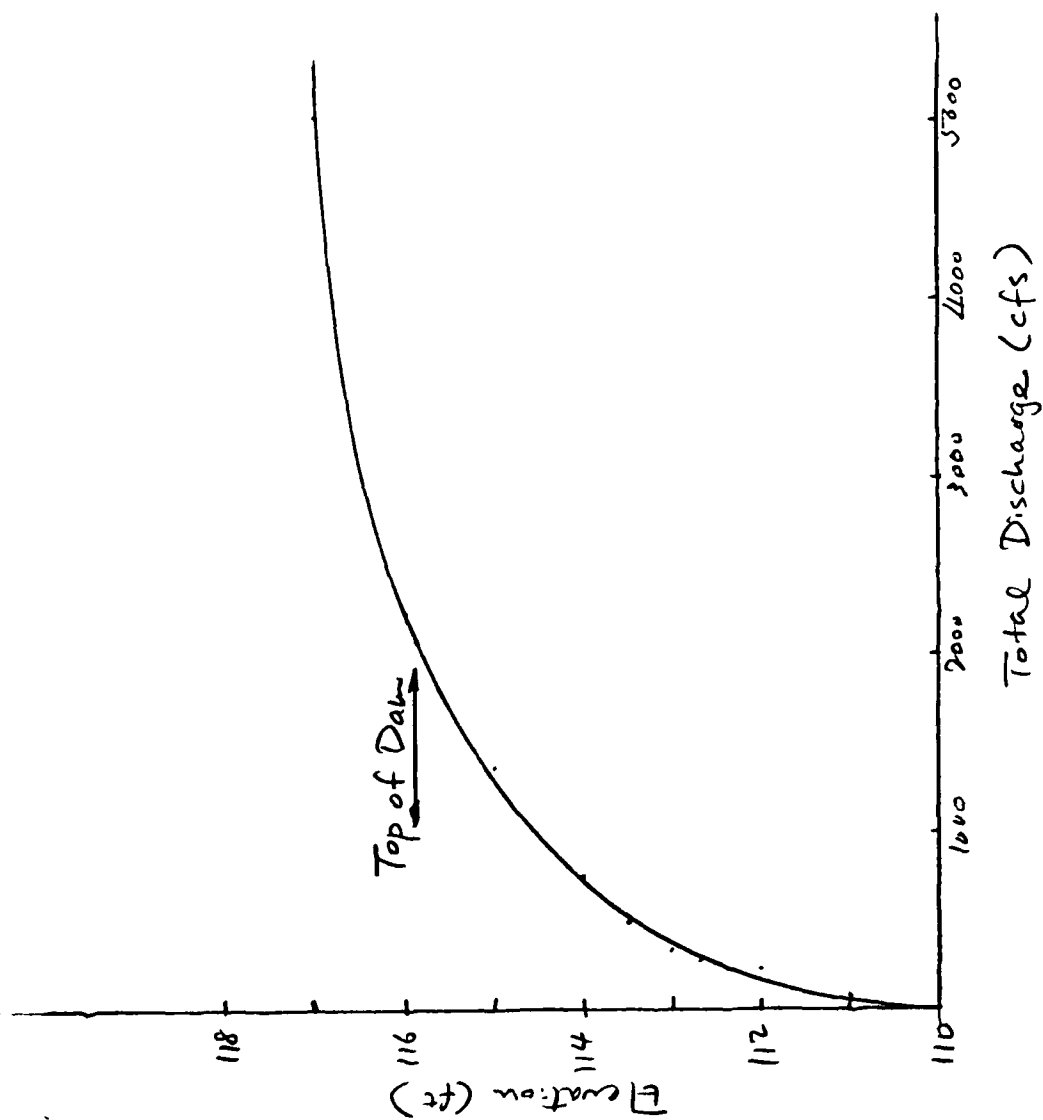
WEIR FLOW OF EMERGENCY SPILLWAY AND OVERDAM DETERMINED BY $Q = CLH^{3/2}$
 C VALUES OBTAINED FROM "HANDBOOK OF HYDRAULICS", Pg 5-46, TABLE 5-3, breadth = 15 ft
 * DROP INLET SPILLWAY OUTFLOW FROM SCS CALCULATIONS, $Q = C_p H^{1/2}$, $C_p = 63.8$

DISCHARGE CAPACITY

BY RWG DATE NOV 12, 1980 OUTFLOW CALCULATIONS
 CKD Date 3/27/81 LAKE ROBERT ROOKER

JOB NO. 80145
 SHEET NO. 4 OF

SPILLWAY RATING CURVE



BY mg
CKD RWC

DATE 3/24/81
DATE 3/28/81

Robert Rook Lake Dam

JOB NO. 80145
SHEET NO. 5 OF 5

Reservoir Storage

Data obtained from Design Calculations
by U.S. Dept of Agriculture Soil Conservation
Service dated 3-26-63 for Newark
YMCA dam

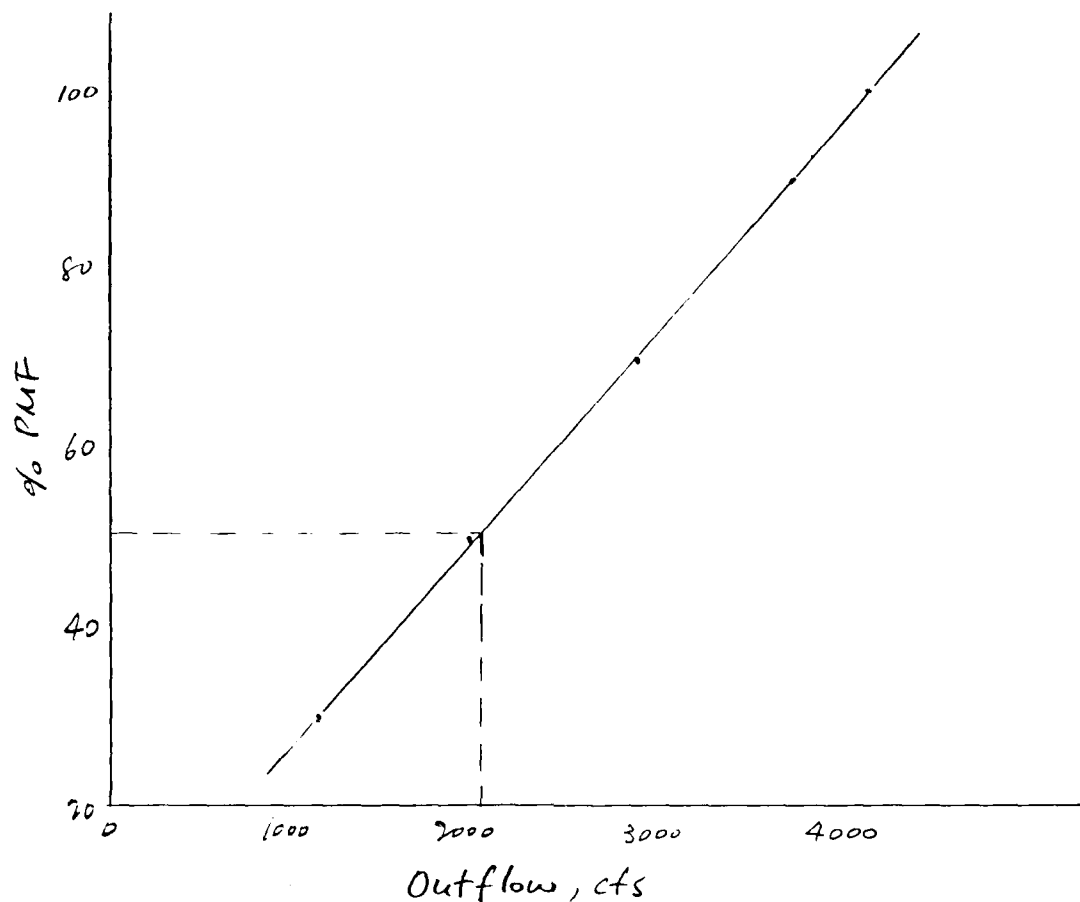
Elev ft	Storage ac ft
110	0
111	11.5
112	22.9
113	36.0
114	49.2
115	63.5
116	79.5
117	97.5
118	113.9

BY RM DATE 9-30-80 Lake Robert CookeJOB NO. 5014.5CKD RWG DATE Nov 25/80SHEET NO. 5 OF

SUMMARY OF HYDROGRAPH AND FLOOD ROUTING

- 1) Hydrograph & routing calculated using HEC-1.
- 2) PMF for LAKE ROBERT ROOKE DAM
is 4236 cfs (routed to 4239 cfs).
- 3) Routing of PMF indicates that the dam will overtop by 0.82 ft.
- 4) Routing of $\frac{1}{2}$ PMF indicates that the dam will not overtop.

BY <u>Py</u>	DATE <u>5/81</u>	<u>HEC-1 Summary</u>	JOB NO. <u>80145</u>
CKD <u>RWG</u>	DATE <u>5/81</u>	<u>Robert Rook</u>	SHEET NO. <u>6</u> OF <u> </u>



% PMF vs Outflow indicates
the dam can adequately pass approx. 51% of PMF
at 2093 cfs

BY <u>Py</u>	DATE <u>5/81</u>	<u>Robert Roake Dam</u>	JOB NO. <u>80145</u>
CKD <u>RWC</u>	DATE <u>5/81</u>		SHEET NO. <u>7</u> OF <u> </u>

DEMAND ANALYSISSTRUCTURE

There presently exists a 16" diameter
cast iron pipe low level outlet structure.
Its operating condition is unknown,
however for this analysis¹ will assume
the structure to be operable.

OUTFLOW CAPACITY

Pipe diam. = 16" ($n = .025$)

Length = 36 ft Invert = 97

Normal pool = 110.0 $\&$ invert = 97.67

Flow will be calculated using $Q = C_p H^{1/2}$
where $C_p = A_p \sqrt{\frac{2g}{1 + K_m + K_p L}}$

$A_p = 1.40 \text{ ft}^2$

$K_m = .90$ $K_p = .0789$ $\therefore C_p = 5.16$

$Q = 5.16 H^{1/2}$

Elev. (ft)	Head (ft)	Q (cfs)	Qout avg (cfs)
110	12.33	18	17.7
109	11.33	17.37	16.6
107	9.33	15.76	15.35
106	8.33	14.9	13.9
104	6.33	12.9	11.8
102	4.33	10.7	9.25
100	2.33	7.8	5.35
98	.33	2.9	1.45
97	0	0	

BY RMDATE 9-29-80Lee Robert RottleJOB NO. 80195CKD PageDATE 5/81dimuturSHEET NO. 8 OF

STORAGE

Elev. (ft)	Area (ac)	Average Area (ac)	ΔH (ft)	Inc. Volume (ac-ft)	Volume (ac-ft)
110	10.75	10.40	1	10.40	68.97
109	10.04	9.18	2	18.36	58.57
107	8.32	7.83	1	7.83	40.21
106	7.33	6.35	2	12.70	32.38
104	5.36	4.57	2	9.14	19.68
102	3.77	3.05	2	6.10	10.54
100	2.33	1.67	2	3.34	4.44
98	1.01	0.55	2	1.10	1.10
96	0.08				

Data acquired from SCS design calculations
See Appendix 1.

BY mgDATE 5/81Lake Robert Park DamJOB NO. 80145CKD RWGDATE 5/81SHEET NO. 9OF

Assume inflow to be 2 cfs / sq mi

$$Q_{in} = 2 \times 1.05 = 2.1 \text{ cfs}$$

Elev. (ft)	$Q_{out \text{ avg}}$ (cfs)	Q_{net}^* (cfs)	$\Delta \text{Storage}$ (ac-ft)	$\Delta t \text{ (hr)}$	$\Sigma \Delta t \text{ (hr)}$
110					
109	17.7	15.6	10.40	8.07	8.07
107	16.6	14.5	18.36	15.32	23.39 - 1 day
106	15.35	13.25	7.83	7.15	30.54
104	13.9	11.8	12.70	13.02	43.56
102	11.8	9.7	9.14	11.40	54.96
100	9.25	7.15	6.10	10.32	65.28
98	5.35	3.25	3.34	12.44	77.72 - 3 d.
97	1.45	-	1.10	-	

$$* Q_{net} = Q_{out \text{ avg}} - Q_{in} = Q_{out \text{ avg}} - 10$$

Lake can be lowered 3 ft in about 1 day
and 12 ft in about 3 days.

BY Ry DATE 5/81 Lake Robert Ponds Dam JOB NO. 80165
CKD RWG DATE 5/81 SHEET NO. 10 OF

HEC-1 OUTPUT
LAKE ROBERT ROOKE DAM

RODKOUT 16151 MAY 16, '81

FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79

1 A1
2 A2
3 A3
4 B 290
5 B1 3
6 K 0
7 K1 COMPUTE HYDROGRAPH
8 M 1 2 1.05
9 P 0 22.0 112 123 133 142
10 T
11 W2 .85
12 X -2
13 K 1
14 K1 ROUTING COMPUTATIONS
15 Y
16 Y1 1
17 Y4 130
18 Y5 0
19 \$S 0
20 \$E 110.0
21 \$3 110
22 \$R 115.9
23 K

LAKE ROBERT ROOKE DAM (00262)
INFLOW HYDROGRAPHY AND ROUTING
N J DAM INSPECTION

0	10	0	0	0	0	0	0
1	1	1	1	1	1	1	1

115.0 112.7 113.0 113.5 114.0 115.0 116.0 117.0
75 262 318 496 742 1380 2093 2231
11.5 22.9 36.0 49.2 63.5 79.5 97.5 113.9
111.0 112.0 113.0 114.0 115.0 116.0 117.0 118.0

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT 1
ROUTE HYDROGRAPH TO 2
END OF NETWORK

FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79

RUN DATE# 81/05/16.
TIME# 16.50.47.

LAKE ROBERT ROOKE DAM (00262)
INFLOW HYDROGRAPHY AND ROUTING
N J DAM INSPECTION

NO	MHR	NMIN	IDAY	JHR	ININ	METRC	IPLT	IPRT	NSTAN
290	0	10	0	0	0	0	0	0	0
			JOPEK	NUT	LNUPT	TRACE			
			3	0	0	0			

JOB SPECIFICATION

SUB-AREA RUNOFF COMPUTATION

COMPUTE HYDROGRAPH

ISTAQ ICOMP IECON ITAPE JPLT JPRT INAME ISTAGE IAUO
1 0 0 0 0 0 1 0 0

HYDROGRAPH DATA

IHYDO IUNG TAKEA SNAP TRSDA TRSPC NATIO ISNOW ISAME LOCAL
1 2 1.05 0.00 1.05 .80 0.000 0 0 0

PRECIP DATA

SPFE PMS R6 R12 R24 R48 R72 R96
0.00 22.00 112.00 123.00 133.00 142.00 0.00 0.00

LOSS DATA

LROPT STKKR ULTKR RTIUL ERAIN STKRS RTIUK STRTL CNSTL ALSHX RTIMP
0 0.00 0.00 1.00 0.00 0.00 1.00 1.00 .15 0.00 0.00

UNIT HYDROGRAPH DATA

TC= 0.00 LAG= .85

RECESSION DATA

STRIU= -2.00 ORCSN= 0.00 RTIUK= 1.00

UNIT HYDROGRAPH 27 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .85 VOL= 1.00 217.
46. 140. 292. 454. 535. 539. 486. 408. 300. 217.
162. 124. 93. 69. 52. 38. 28. 21. 16. 12.
9. 7. 5. 4. 3. 2. 1.

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.10	1	.00	0.00	.00	2.	1.02	.20	146	.02	0.00	.02	2.
1.01	.20	2	.00	0.00	.00	2.	1.02	.30	147	.02	0.00	.02	2.
1.01	.30	3	.00	0.00	.00	2.	1.02	.40	148	.02	0.00	.02	2.
1.01	.40	4	.00	0.00	.00	2.	1.02	.50	149	.02	0.00	.02	2.
1.01	.50	5	.00	0.00	.00	2.	1.02	1.00	150	.02	0.00	.02	2.
1.01	1.00	6	.00	0.00	.00	2.	1.02	1.10	151	.02	0.00	.02	2.
1.01	1.10	7	.00	0.00	.00	2.	1.02	1.20	152	.02	0.00	.02	2.
1.01	1.20	8	.00	0.00	.00	2.	1.02	1.30	153	.02	0.00	.02	2.
1.01	1.30	9	.00	0.00	.00	2.	1.02	1.40	154	.02	0.00	.02	2.
1.01	1.40	10	.00	0.00	.00	2.	1.02	1.50	155	.02	0.00	.02	2.
1.01	1.50	11	.00	0.00	.00	2.	1.02	2.00	156	.02	0.00	.02	2.
1.01	2.00	12	.00	0.00	.00	2.	1.02	2.10	157	.02	0.00	.02	2.
1.01	2.10	13	.00	0.00	.00	2.	1.02	2.20	158	.02	0.00	.02	2.
1.01	2.20	14	.00	0.00	.00	2.	1.02	2.30	159	.02	0.00	.02	2.
1.01	2.30	15	.00	0.00	.00	2.	1.02	2.40	160	.02	0.00	.02	2.
1.01	2.40	16	.00	0.00	.00	2.	1.02	2.50	161	.02	0.00	.02	2.
1.01	2.50	17	.00	0.00	.00	2.	1.02	3.00	162	.02	0.00	.02	2.
1.01	3.00	18	.00	0.00	.00	2.	1.02	3.10	163	.02	0.00	.02	2.
1.01	3.10	19	.00	0.00	.00	2.	1.02	3.20	164	.02	0.00	.02	2.
1.01	3.20	20	.00	0.00	.00	2.	1.02	3.30	165	.02	0.00	.02	2.
1.01	3.30	21	.00	0.00	.00	2.	1.02	3.40	166	.02	0.00	.02	2.
1.01	3.40	22	.00	0.00	.00	2.	1.02	3.50	167	.02	0.00	.02	2.
1.01	3.50	23	.00	0.00	.00	2.	1.02	4.00	168	.02	0.00	.02	2.
1.01	4.00	24	.00	0.00	.00	2.	1.02	4.10	169	.02	0.00	.02	2.
1.01	4.10	25	.00	0.00	.00	2.	1.02	4.20	170	.02	0.00	.02	2.
1.01	4.20	26	.00	0.00	.00	2.	1.02	4.30	171	.02	0.00	.02	2.
1.01	4.30	27	.00	0.00	.00	2.	1.02	4.40	172	.02	0.00	.02	2.
1.01	4.40	28	.00	0.00	.00	2.	1.02	4.50	173	.02	0.00	.02	2.
1.01	4.50	29	.00	0.00	.00	2.	1.02	5.00	174	.02	0.00	.02	2.
1.01	5.00	30	.00	0.00	.00	2.	1.02	5.10	175	.02	0.00	.02	2.
1.01	5.10	31	.00	0.00	.00	2.	1.02	5.20	176	.02	0.00	.02	2.
1.01	5.20	32	.00	0.00	.00	2.	1.02	5.30	177	.02	0.00	.02	2.
1.01	5.30	33	.00	0.00	.00	2.	1.02	5.40	178	.02	0.00	.02	2.
1.01	5.40	34	.00	0.00	.00	2.	1.02	5.50	179	.02	0.00	.02	2.

1.01	6.00	36	.00	0.00	.00	2.	1.02	6.10	181	.05	.03	.03	3.
1.01	6.10	37	.00	0.00	.00	2.	1.02	6.20	182	.05	.03	.03	7.
1.01	6.20	38	.00	0.00	.00	2.	1.02	6.30	183	.05	.03	.03	16.
1.01	6.30	39	.00	0.00	.00	2.	1.02	6.40	184	.05	.03	.03	29.
1.01	6.40	40	.00	0.00	.00	2.	1.02	6.50	185	.05	.03	.03	44.
1.01	6.50	41	.00	0.00	.00	2.	1.02	7.00	186	.05	.03	.03	60.
1.01	7.00	42	.00	0.00	.00	2.	1.02	7.10	187	.05	.03	.03	74.
1.01	7.10	43	.00	0.00	.00	2.	1.02	7.20	188	.05	.03	.03	86.
1.01	7.20	44	.00	0.00	.00	2.	1.02	7.30	189	.05	.03	.02	94.
1.01	7.30	45	.00	0.00	.00	2.	1.02	7.40	190	.05	.03	.03	100.
1.01	7.40	46	.00	0.00	.00	2.	1.02	7.50	191	.05	.03	.03	105.
1.01	7.50	47	.00	0.00	.00	2.	1.02	8.00	192	.05	.03	.03	109.
1.01	8.00	48	.00	0.00	.00	2.	1.02	8.10	193	.05	.03	.03	111.
1.01	8.10	49	.00	0.00	.00	2.	1.02	8.20	194	.05	.03	.03	113.
1.01	8.20	50	.00	0.00	.00	2.	1.02	8.30	195	.05	.03	.03	115.
1.01	8.30	51	.00	0.00	.00	2.	1.02	8.40	196	.05	.03	.03	116.
1.01	8.40	52	.00	0.00	.00	2.	1.02	8.50	197	.05	.03	.03	117.
1.01	8.50	53	.00	0.00	.00	2.	1.02	9.00	198	.05	.03	.03	117.
1.01	9.00	54	.00	0.00	.00	2.	1.02	9.10	199	.05	.03	.03	118.
1.01	9.10	55	.00	0.00	.00	2.	1.02	9.20	200	.05	.03	.03	118.
1.01	9.20	56	.00	0.00	.00	2.	1.02	9.30	201	.05	.03	.03	118.
1.01	9.30	57	.00	0.00	.00	2.	1.02	9.40	202	.05	.03	.03	119.
1.01	9.40	58	.00	0.00	.00	2.	1.02	9.50	203	.05	.03	.03	119.
1.01	9.50	59	.00	0.00	.00	2.	1.02	10.00	204	.05	.03	.03	119.
1.01	10.00	60	.00	0.00	.00	2.	1.02	10.10	205	.05	.03	.03	119.
1.01	10.10	61	.00	0.00	.00	2.	1.02	10.20	206	.05	.03	.03	119.
1.01	10.20	62	.00	0.00	.00	2.	1.02	10.30	207	.05	.03	.03	119.
1.01	10.30	63	.00	0.00	.00	2.	1.02	10.40	208	.05	.03	.03	119.
1.01	10.40	64	.00	0.00	.00	2.	1.02	10.50	209	.05	.03	.03	119.
1.01	10.50	65	.00	0.00	.00	2.	1.02	11.00	210	.05	.03	.03	119.
1.01	11.00	66	.00	0.00	.00	2.	1.02	11.10	211	.05	.03	.03	119.
1.01	11.10	67	.00	0.00	.00	2.	1.02	11.20	212	.05	.03	.03	119.
1.01	11.20	68	.00	0.00	.00	2.	1.02	11.30	213	.05	.03	.03	119.
1.01	11.30	69	.00	0.00	.00	2.	1.02	11.40	214	.05	.03	.03	119.
1.01	11.40	70	.00	0.00	.00	2.	1.02	11.50	215	.05	.03	.03	119.
1.01	11.50	71	.00	0.00	.00	2.	1.02	12.00	216	.05	.03	.03	119.
1.01	12.00	72	.00	0.00	.00	2.	1.02	12.10	217	.33	.30	.03	132.
1.01	12.10	73	.02	0.00	.02	2.	1.02	12.20	218	.33	.30	.03	170.
1.01	12.20	74	.02	0.00	.02	2.	1.02	12.30	219	.33	.30	.03	251.
1.01	12.30	75	.02	0.00	.02	2.	1.02	12.40	220	.33	.30	.03	375.
1.01	12.40	76	.02	0.00	.02	2.	1.02	12.50	221	.33	.30	.03	522.
1.01	12.50	77	.02	0.00	.02	2.	1.02	13.00	222	.33	.30	.03	670.
1.01	13.00	78	.02	0.00	.02	2.	1.02	13.10	223	.39	.37	.03	807.
1.01	13.10	79	.03	0.00	.03	2.	1.02	13.20	224	.39	.37	.03	928.
1.01	13.20	80	.03	0.00	.03	2.	1.02	13.30	225	.39	.37	.03	1030.
1.01	13.30	81	.03	0.00	.03	2.	1.02	13.40	226	.39	.37	.03	1119.
1.01	13.40	82	.03	0.00	.03	2.	1.02	13.50	227	.39	.37	.03	1199.
1.01	13.50	83	.03	0.00	.03	2.	1.02	14.00	228	.39	.37	.03	1268.
1.01	14.00	84	.03	0.00	.03	2.	1.02	14.10	229	.49	.47	.03	1330.
1.01	14.10	85	.03	0.00	.03	2.	1.02	14.20	230	.49	.47	.03	1390.
1.01	14.20	86	.03	0.00	.03	2.	1.02	14.30	231	.49	.47	.03	1453.
1.01	14.30	87	.03	0.00	.03	2.	1.02	14.40	232	.49	.47	.03	1522.
1.01	14.40	88	.03	0.00	.03	2.	1.02	14.50	233	.49	.47	.03	1593.
1.01	14.50	89	.03	0.00	.03	2.	1.02	15.00	234	.49	.47	.03	1660.
1.01	15.00	90	.03	0.00	.03	2.	1.02	15.10	235	.45	.42	.03	1717.
1.01	15.10	91	.03	0.00	.03	2.	1.02	15.20	236	.75	.72	.03	1773.
1.01	15.20	92	.05	0.00	.05	2.	1.02	15.30	237	1.35	1.32	.03	1865.
1.01	15.30	93	.09	0.00	.09	2.	1.02	15.40	238	3.37	3.35	.03	2136.
1.01	15.40	94	.23	.06	.16	3.	1.02	15.50	239	.97	.95	.03	2614.
1.01	15.50	95	.07	.04	.03	13.	1.02	16.00	240	.60	.57	.03	3277.
1.01	16.00	96	.04	.02	.03	27.	1.02	16.10	241	.46	.43	.03	3908.
1.01	16.10	97	.03	.01	.03	46.	1.02	16.20	242	.46	.43	.03	4233.
1.01	16.20	98	.03	.01	.03	61.	1.02	16.30	243	.44	.41	.03	4236.
1.01	16.30	99	.03	.01	.03	69.	1.02	16.40	244	.46	.43	.03	4992.
1.01	16.40	100	.03	.01	.03	70.	1.02	16.50	245	.46	.43	.03	5617.

1.01	17.00	102	.03	.01	.03	58.	1.02	17.10	247	.36	.34	.03	2791.
1.01	17.10	103	.02	0.00	.02	50.	1.02	17.20	248	.36	.34	.03	2515.
1.01	17.20	104	.02	0.00	.02	43.	1.02	17.30	249	.36	.34	.03	2300.
1.01	17.30	105	.02	0.00	.02	37.	1.02	17.40	250	.36	.34	.03	2111.
1.01	17.40	106	.02	0.00	.02	31.	1.02	17.50	251	.36	.34	.03	1949.
1.01	17.50	107	.02	0.00	.02	25.	1.02	18.00	252	.36	.34	.03	1814.
1.01	18.00	108	.02	0.00	.02	20.	1.02	18.10	253	.03	.00	.03	1689.
1.01	18.10	109	.00	0.00	.00	16.	1.02	18.20	254	.03	.00	.03	1556.
1.01	18.20	110	.00	0.00	.00	12.	1.02	18.30	255	.03	.00	.03	1395.
1.01	18.30	111	.00	0.00	.00	10.	1.02	18.40	256	.03	.00	.03	1198.
1.01	18.40	112	.00	0.00	.00	8.	1.02	18.50	257	.03	.00	.03	986.
1.01	18.50	113	.00	0.00	.00	6.	1.02	19.00	258	.03	.00	.03	780.
1.01	19.00	114	.00	0.00	.00	5.	1.02	19.10	259	.03	.00	.03	600.
1.01	19.10	115	.00	0.00	.00	4.	1.02	19.20	260	.03	.00	.03	450.
1.01	19.20	116	.00	0.00	.00	3.	1.02	19.30	261	.03	.00	.03	340.
1.01	19.30	117	.00	0.00	.00	3.	1.02	19.40	262	.03	.00	.03	258.
1.01	19.40	118	.00	0.00	.00	3.	1.02	19.50	263	.03	.00	.03	197.
1.01	19.50	119	.00	0.00	.00	3.	1.02	20.00	264	.03	.00	.03	149.
1.01	20.00	120	.00	0.00	.00	3.	1.02	20.10	265	.03	.00	.03	114.
1.01	20.10	121	.00	0.00	.00	2.	1.02	20.20	266	.03	.00	.03	89.
1.01	20.20	122	.00	0.00	.00	2.	1.02	20.30	267	.03	.00	.03	71.
1.01	20.30	123	.00	0.00	.00	2.	1.02	20.40	268	.03	.00	.03	57.
1.01	20.40	124	.00	0.00	.00	2.	1.02	20.50	269	.03	.00	.03	47.
1.01	20.50	125	.00	0.00	.00	2.	1.02	21.00	270	.03	.00	.03	40.
1.01	21.00	126	.00	0.00	.00	2.	1.02	21.10	271	.03	.00	.03	34.
1.01	21.10	127	.00	0.00	.00	2.	1.02	21.20	272	.03	.00	.03	30.
1.01	21.20	128	.00	0.00	.00	2.	1.02	21.30	273	.03	.00	.03	27.
1.01	21.30	129	.00	0.00	.00	2.	1.02	21.40	274	.03	.00	.03	25.
1.01	21.40	130	.00	0.00	.00	2.	1.02	21.50	275	.03	.00	.03	23.
1.01	21.50	131	.00	0.00	.00	2.	1.02	22.00	276	.03	.00	.03	22.
1.01	22.00	132	.00	0.00	.00	2.	1.02	22.10	277	.03	.00	.03	21.
1.01	22.10	133	.00	0.00	.00	2.	1.02	22.20	278	.03	.00	.03	20.
1.01	22.20	134	.00	0.00	.00	2.	1.02	22.30	279	.03	.00	.03	20.
1.01	22.30	135	.00	0.00	.00	2.	1.02	22.40	280	.03	.00	.03	20.
1.01	22.40	136	.00	0.00	.00	2.	1.02	22.50	281	.03	.00	.03	20.
1.01	22.50	137	.00	0.00	.00	2.	1.02	23.00	282	.03	.00	.03	20.
1.01	23.00	138	.00	0.00	.00	2.	1.02	23.10	283	.03	.00	.03	20.
1.01	23.10	139	.00	0.00	.00	2.	1.02	23.20	284	.03	.00	.03	20.
1.01	23.20	140	.00	0.00	.00	2.	1.02	23.30	285	.03	.00	.03	20.
1.01	23.30	141	.00	0.00	.00	2.	1.02	23.40	286	.03	.00	.03	20.
1.01	23.40	142	.00	0.00	.00	2.	1.02	23.50	287	.03	.00	.03	20.
1.01	23.50	143	.00	0.00	.00	2.	1.03	0.00	288	.03	.00	.03	20.
1.02	0.00	144	.00	0.00	.00	2.	1.03	.10	289	0.00	0.00	0.00	20.
1.02	.10	145	.02	0.00	.02	2.	1.03	.20	290	0.00	0.00	0.00	19.

SUM 24.99 20.16 4.83 R2450.
(635.)(512.)(123.)(2334.72)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4236.	2024.	566.	284.	82451.
CMS	120.	57.	16.	8.	2335.
INCHES		17.93	20.06	20.29	20.29
MM		455.44	509.47	515.38	515.38
AC-FT		1004.	1123.	1136.	1136.
THOUS CU M		1238.	1385.	1401.	1401.

ROUTING COMPUTATIONS

STAGE	110.00	111.00	112.70	113.00	113.50	114.00	115.00	115.90	116.00
FLOW	0.00	75.00	262.00	318.00	496.00	742.00	1380.00	2093.00	2231.00
CAPACITY=	0.	12.	23.	36.	49.	64.	80.	98.	114.
ELEVATION=	110.	111.	112.	113.	114.	115.	116.	117.	118.

IAM DATA			
TOPEL	COUD	EXPR	DAMWID
115.9	0.0	0.0	0.

END-OF-PERIOD HYDROGRAPH ORDINATES							
MO.DA	HR.MK	PERIOD	HOURS	INFLOW	OUTFLOW	STORAGE	STAGE
1.01	.10	1	.17	2.	0.	0.	110.0
1.01	.20	2	.33	2.	0.	0.	110.0
1.01	.30	3	.50	2.	0.	0.	110.0
1.01	.40	4	.67	2.	1.	0.	110.0
1.01	.50	5	.83	2.	1.	0.	110.0
1.01	1.00	6	1.00	2.	1.	0.	110.0
1.01	1.10	7	1.17	2.	1.	0.	110.0
1.01	1.20	8	1.33	2.	1.	0.	110.0
1.01	1.30	9	1.50	2.	1.	0.	110.0
1.01	1.40	10	1.67	2.	1.	0.	110.0
1.01	1.50	11	1.83	2.	1.	0.	110.0
1.01	2.00	12	2.00	2.	1.	0.	110.0
1.01	2.10	13	2.17	2.	1.	0.	110.0
1.01	2.20	14	2.33	2.	2.	0.	110.0
1.01	2.30	15	2.50	2.	2.	0.	110.0
1.01	2.40	16	2.67	2.	2.	0.	110.0
1.01	2.50	17	2.83	2.	2.	0.	110.0
1.01	3.00	18	3.00	2.	2.	0.	110.0
1.01	3.10	19	3.17	2.	2.	0.	110.0
1.01	3.20	20	3.33	2.	2.	0.	110.0
1.01	3.30	21	3.50	2.	2.	0.	110.0
1.01	3.40	22	3.67	2.	2.	0.	110.0
1.01	3.50	23	3.83	2.	2.	0.	110.0
1.01	4.00	24	4.00	2.	2.	0.	110.0
1.01	4.10	25	4.17	2.	2.	0.	110.0
1.01	4.20	26	4.33	2.	2.	0.	110.0
1.01	4.30	27	4.50	2.	2.	0.	110.0
1.01	4.40	28	4.67	2.	2.	0.	110.0
1.01	4.50	29	4.83	2.	2.	0.	110.0
1.01	5.00	30	5.00	2.	2.	0.	110.0
1.01	5.10	31	5.17	2.	2.	0.	110.0
1.01	5.20	32	5.33	2.	2.	0.	110.0
1.01	5.30	33	5.50	2.	2.	0.	110.0
1.01	5.40	34	5.67	2.	2.	0.	110.0
1.01	5.50	35	5.83	2.	2.	0.	110.0
1.01	6.00	36	6.00	2.	2.	0.	110.0
1.01	6.10	37	6.17	2.	2.	0.	110.0
1.01	6.20	38	6.33	2.	2.	0.	110.0

1.01	6.40	40	6.67	2.	2.	0.	110.0
1.01	6.50	41	6.83	2.	2.	0.	110.0
1.01	7.00	42	7.00	2.	2.	0.	110.0
1.01	7.10	43	7.17	2.	2.	0.	110.0
1.01	7.20	44	7.33	2.	2.	0.	110.0
1.01	7.30	45	7.50	2.	2.	0.	110.0
1.01	7.40	46	7.67	2.	2.	0.	110.0
1.01	7.50	47	7.83	2.	2.	0.	110.0
1.01	8.00	48	8.00	2.	2.	0.	110.0
1.01	8.10	49	8.17	2.	2.	0.	110.0
1.01	8.20	50	8.33	2.	2.	0.	110.0
1.01	8.30	51	8.50	2.	2.	0.	110.0
1.01	8.40	52	8.67	2.	2.	0.	110.0
1.01	8.50	53	8.83	2.	2.	0.	110.0
1.01	9.00	54	9.00	2.	2.	0.	110.0
1.01	9.10	55	9.17	2.	2.	0.	110.0
1.01	9.20	56	9.33	2.	2.	0.	110.0
1.01	9.30	57	9.50	2.	2.	0.	110.0
1.01	9.40	58	9.67	2.	2.	0.	110.0
1.01	9.50	59	9.83	2.	2.	0.	110.0
1.01	10.00	60	10.00	2.	2.	0.	110.0
1.01	10.10	61	10.17	2.	2.	0.	110.0
1.01	10.20	62	10.33	2.	2.	0.	110.0
1.01	10.30	63	10.50	2.	2.	0.	110.0
1.01	10.40	64	10.67	2.	2.	0.	110.0
1.01	10.50	65	10.83	2.	2.	0.	110.0
1.01	11.00	66	11.00	2.	2.	0.	110.0
1.01	11.10	67	11.17	2.	2.	0.	110.0
1.01	11.20	68	11.33	2.	2.	0.	110.0
1.01	11.30	69	11.50	2.	2.	0.	110.0
1.01	11.40	70	11.67	2.	2.	0.	110.0
1.01	11.50	71	11.83	2.	2.	0.	110.0
1.01	12.00	72	12.00	2.	2.	0.	110.0
1.01	12.10	73	12.17	2.	2.	0.	110.0
1.01	12.20	74	12.33	2.	2.	0.	110.0
1.01	12.30	75	12.50	2.	2.	0.	110.0
1.01	12.40	76	12.67	2.	2.	0.	110.0
1.01	12.50	77	12.83	2.	2.	0.	110.0
1.01	13.00	78	13.00	2.	2.	0.	110.0
1.01	13.10	79	13.17	2.	2.	0.	110.0
1.01	13.20	80	13.33	2.	2.	0.	110.0
1.01	13.30	81	13.50	2.	2.	0.	110.0
1.01	13.40	82	13.67	2.	2.	0.	110.0
1.01	13.50	83	13.83	2.	2.	0.	110.0
1.01	14.00	84	14.00	2.	2.	0.	110.0
1.01	14.10	85	14.17	2.	2.	0.	110.0
1.01	14.20	86	14.33	2.	2.	0.	110.0
1.01	14.30	87	14.50	2.	2.	0.	110.0
1.01	14.40	88	14.67	2.	2.	0.	110.0
1.01	14.50	89	14.83	2.	2.	0.	110.0
1.01	15.00	90	15.00	2.	2.	0.	110.0
1.01	15.10	91	15.17	2.	2.	0.	110.0
1.01	15.20	92	15.33	2.	2.	0.	110.0
1.01	15.30	93	15.50	2.	2.	0.	110.0
1.01	15.40	94	15.67	3.	2.	0.	110.0
1.01	15.50	95	15.83	13.	3.	0.	110.0
1.01	16.00	96	16.00	27.	4.	1.	110.1
1.01	16.10	97	16.17	46.	7.	1.	110.1
1.01	16.20	98	16.33	61.	2.	2.	110.1
1.01	16.30	99	16.50	69.	16.	2.	110.2
1.01	16.40	100	16.67	70.	20.	3.	110.3
1.01	16.50	101	16.83	44.	24.	4.	110.3
1.01	17.00	102	17.00	58.	28.	4.	110.4
1.01	17.10	103	17.17	50.	30.	5.	110.4
1.01	17.20	104	17.33	43.	31.	5.	110.4

1.01	17.40	106	17.67	31.	32.	5.	110.4
1.01	17.50	107	17.83	25.	32.	5.	110.4
1.01	18.00	108	18.00	20.	31.	5.	110.4
1.01	18.10	109	18.17	16.	30.	5.	110.4
1.01	18.20	110	18.33	12.	29.	4.	110.4
1.01	18.30	111	18.50	10.	27.	4.	110.4
1.01	18.40	112	18.67	8.	25.	4.	110.3
1.01	18.50	113	18.83	6.	24.	4.	110.3
1.01	19.00	114	19.00	5.	22.	3.	110.3
1.01	19.10	115	19.17	4.	21.	3.	110.3
1.01	19.20	116	19.33	4.	19.	3.	110.3
1.01	19.30	117	19.50	3.	18.	3.	110.2
1.01	19.40	118	19.67	3.	17.	3.	110.2
1.01	19.50	119	19.83	3.	16.	2.	110.2
1.01	20.00	120	20.00	3.	14.	2.	110.2
1.01	20.10	121	20.17	2.	13.	2.	110.2
1.01	20.20	122	20.33	2.	12.	2.	110.2
1.01	20.30	123	20.50	2.	12.	2.	110.2
1.01	20.40	124	20.67	2.	11.	2.	110.1
1.01	20.50	125	20.83	2.	10.	2.	110.1
1.01	21.00	126	21.00	2.	9.	1.	110.1
1.01	21.10	127	21.17	2.	9.	1.	110.1
1.01	21.20	128	21.33	2.	8.	1.	110.1
1.01	21.30	129	21.50	2.	8.	1.	110.1
1.01	21.40	130	21.67	2.	7.	1.	110.1
1.01	21.50	131	21.83	2.	7.	1.	110.1
1.01	22.00	132	22.00	2.	6.	1.	110.1
1.01	22.10	133	22.17	2.	6.	1.	110.1
1.01	22.20	134	22.33	2.	6.	1.	110.1
1.01	22.30	135	22.50	2.	5.	1.	110.1
1.01	22.40	136	22.67	2.	5.	1.	110.1
1.01	22.50	137	22.83	2.	5.	1.	110.1
1.01	23.00	138	23.00	2.	5.	1.	110.1
1.01	23.10	139	23.17	2.	4.	1.	110.1
1.01	23.20	140	23.33	2.	4.	1.	110.1
1.01	23.30	141	23.50	2.	4.	1.	110.1
1.01	23.40	142	23.67	2.	4.	1.	110.1
1.01	23.50	143	23.83	2.	4.	1.	110.0
1.02	0.00	144	24.00	2.	4.	1.	110.0
1.02	.10	145	24.17	2.	3.	1.	110.0
1.02	.20	146	24.33	2.	3.	1.	110.0
1.02	.30	147	24.50	2.	3.	0.	110.0
1.02	.40	148	24.67	2.	3.	0.	110.0
1.02	.50	149	24.83	2.	3.	0.	110.0
1.02	1.00	150	25.00	2.	3.	0.	110.0
1.02	1.10	151	25.17	2.	3.	0.	110.0
1.02	1.20	152	25.33	2.	3.	0.	110.0
1.02	1.30	153	25.50	2.	3.	0.	110.0
1.02	1.40	154	25.67	2.	3.	0.	110.0
1.02	1.50	155	25.83	2.	3.	0.	110.0
1.02	2.00	156	26.00	2.	3.	0.	110.0
1.02	2.10	157	26.17	2.	3.	0.	110.0
1.02	2.20	158	26.33	2.	3.	0.	110.0
1.02	2.30	159	26.50	2.	2.	0.	110.0
1.02	2.40	160	26.67	2.	2.	0.	110.0
1.02	2.50	161	26.83	2.	2.	0.	110.0
1.02	3.00	162	27.00	2.	2.	0.	110.0
1.02	3.10	163	27.17	2.	2.	0.	110.0
1.02	3.20	164	27.33	2.	2.	0.	110.0
1.02	3.30	165	27.50	2.	2.	0.	110.0
1.02	3.40	166	27.67	2.	2.	0.	110.0
1.02	3.50	167	27.83	2.	2.	0.	110.0
1.02	4.00	168	28.00	2.	2.	0.	110.0
1.02	4.10	169	28.17	2.	2.	0.	110.0
1.02	4.20	170	28.33	2.	2.	0.	110.0
1.02	4.30	171	28.50	2.	2.	0.	110.0

1.02	4.40	172	28.67	2.	2.	0.	110.0
1.02	4.50	173	28.83	2.	2.	0.	110.0
1.02	5.00	174	29.00	2.	2.	0.	110.0
1.02	5.10	175	29.17	2.	2.	0.	110.0
1.02	5.20	176	29.33	2.	2.	0.	110.0
1.02	5.30	177	29.50	2.	2.	0.	110.0
1.02	5.40	178	29.67	2.	2.	0.	110.0
1.02	5.50	179	29.83	2.	2.	0.	110.0
1.02	6.00	180	30.00	2.	2.	0.	110.0
1.02	6.10	181	30.17	3.	2.	0.	110.0
1.02	6.20	182	30.33	7.	2.	0.	110.0
1.02	6.30	183	30.50	16.	3.	1.	110.0
1.02	6.40	184	30.67	29.	5.	1.	110.1
1.02	6.50	185	30.83	44.	8.	1.	110.1
1.02	7.00	186	31.00	60.	11.	2.	110.2
1.02	7.10	187	31.17	74.	16.	2.	110.2
1.02	7.20	188	31.33	86.	22.	3.	110.3
1.02	7.30	189	31.50	94.	28.	4.	110.4
1.02	7.40	190	31.67	100.	34.	5.	110.4
1.02	7.50	191	31.83	105.	39.	6.	110.5
1.02	8.00	192	32.00	109.	45.	7.	110.6
1.02	8.10	193	32.17	111.	51.	8.	110.7
1.02	8.20	194	32.33	113.	56.	9.	110.7
1.02	8.30	195	32.50	115.	61.	9.	110.8
1.02	8.40	196	32.67	116.	66.	10.	110.9
1.02	8.50	197	32.83	117.	70.	11.	110.9
1.02	9.00	198	33.00	117.	74.	11.	111.0
1.02	9.10	199	33.17	118.	79.	12.	111.0
1.02	9.20	200	33.33	118.	84.	12.	111.1
1.02	9.30	201	33.50	118.	88.	13.	111.1
1.02	9.40	202	33.67	119.	92.	13.	111.2
1.02	9.50	203	33.83	119.	95.	14.	111.2
1.02	10.00	204	34.00	119.	98.	14.	111.2
1.02	10.10	205	34.17	119.	101.	14.	111.2
1.02	10.20	206	34.33	119.	103.	14.	111.3
1.02	10.30	207	34.50	119.	105.	15.	111.3
1.02	10.40	208	34.67	119.	107.	15.	111.3
1.02	10.50	209	34.83	119.	108.	15.	111.3
1.02	11.00	210	35.00	119.	110.	15.	111.3
1.02	11.10	211	35.17	119.	111.	15.	111.3
1.02	11.20	212	35.33	119.	112.	15.	111.3
1.02	11.30	213	35.50	119.	113.	15.	111.3
1.02	11.40	214	35.67	119.	114.	15.	111.4
1.02	11.50	215	35.83	119.	114.	16.	111.4
1.02	12.00	216	36.00	119.	115.	16.	111.4
1.02	12.10	217	36.17	132.	116.	16.	111.4
1.02	12.20	218	36.33	170.	120.	16.	111.4
1.02	12.30	219	36.50	251.	132.	17.	111.5
1.02	12.40	220	36.67	375.	154.	20.	111.7
1.02	12.50	221	36.83	522.	190.	24.	112.0
1.02	13.00	222	37.00	670.	235.	29.	112.5
1.02	13.10	223	37.17	807.	307.	35.	112.9
1.02	13.20	224	37.33	928.	475.	42.	113.4
1.02	13.30	225	37.50	1030.	674.	47.	113.9
1.02	13.40	226	37.67	1119.	852.	52.	114.2
1.02	13.50	227	37.83	1199.	997.	58.	114.4
1.02	14.00	228	38.00	1268.	1108.	57.	114.6
1.02	14.10	229	38.17	1330.	1198.	59.	114.7
1.02	14.20	230	38.33	1390.	1274.	61.	114.8
1.02	14.30	231	38.50	1453.	1343.	63.	114.9
1.02	14.40	232	38.67	1522.	1414.	64.	115.0
1.02	14.50	233	38.83	1593.	1487.	66.	115.1
1.02	15.00	234	39.00	1660.	1558.	67.	115.2
1.02	15.10	235	39.17	1717.	1624.	68.	115.3
1.02	15.20	236	39.33	1773.	1686.	70.	115.4
1.02	15.30	237	39.50	1830.	1748.	71.	115.5

1.02	4.40	172	28.67	2.	2.	0.	110.0
1.02	4.50	173	28.83	2.	2.	0.	110.0
1.02	5.00	174	29.00	2.	2.	0.	110.0
1.02	5.10	175	29.17	2.	2.	0.	110.0
1.02	5.20	176	29.33	2.	2.	0.	110.0
1.02	5.30	177	29.50	2.	2.	0.	110.0
1.02	5.40	178	29.67	2.	2.	0.	110.0
1.02	5.50	179	29.83	2.	2.	0.	110.0
1.02	6.00	180	30.00	2.	2.	0.	110.0
1.02	6.10	181	30.17	3.	2.	0.	110.0
1.02	6.20	182	30.33	7.	2.	0.	110.0
1.02	6.30	183	30.50	16.	3.	1.	110.0
1.02	6.40	184	30.67	29.	5.	1.	110.1
1.02	6.50	185	30.83	44.	8.	1.	110.1
1.02	7.00	186	31.00	60.	11.	2.	110.2
1.02	7.10	187	31.17	74.	16.	2.	110.2
1.02	7.20	188	31.33	86.	22.	3.	110.3
1.02	7.30	189	31.50	94.	28.	4.	110.4
1.02	7.40	190	31.67	100.	34.	5.	110.4
1.02	7.50	191	31.83	105.	39.	6.	110.5
1.02	8.00	192	32.00	109.	45.	7.	110.6
1.02	8.10	193	32.17	111.	51.	8.	110.7
1.02	8.20	194	32.33	113.	56.	9.	110.7
1.02	8.30	195	32.50	115.	61.	9.	110.8
1.02	8.40	196	32.67	116.	66.	10.	110.9
1.02	8.50	197	32.83	117.	70.	11.	110.9
1.02	9.00	198	33.00	117.	74.	11.	111.0
1.02	9.10	199	33.17	118.	79.	12.	111.0
1.02	9.20	200	33.33	118.	84.	12.	111.1
1.02	9.30	201	33.50	118.	88.	13.	111.1
1.02	9.40	202	33.67	119.	92.	13.	111.2
1.02	9.50	203	33.83	119.	95.	14.	111.2
1.02	10.00	204	34.00	119.	98.	14.	111.2
1.02	10.10	205	34.17	119.	101.	14.	111.2
1.02	10.20	206	34.33	119.	103.	14.	111.3
1.02	10.30	207	34.50	119.	105.	15.	111.3
1.02	10.40	208	34.67	119.	107.	15.	111.3
1.02	10.50	209	34.83	119.	108.	15.	111.3
1.02	11.00	210	35.00	119.	110.	15.	111.3
1.02	11.10	211	35.17	119.	111.	15.	111.3
1.02	11.20	212	35.33	119.	112.	15.	111.3
1.02	11.30	213	35.50	119.	113.	15.	111.3
1.02	11.40	214	35.67	119.	114.	15.	111.4
1.02	11.50	215	35.83	119.	114.	16.	111.4
1.02	12.00	216	36.00	119.	115.	16.	111.4
1.02	12.10	217	36.17	132.	116.	16.	111.4
1.02	12.20	218	36.33	170.	120.	16.	111.4
1.02	12.30	219	36.50	251.	132.	17.	111.5
1.02	12.40	220	36.67	375.	154.	20.	111.7
1.02	12.50	221	36.83	522.	190.	24.	112.0
1.02	13.00	222	37.00	670.	235.	29.	112.5
1.02	13.10	223	37.17	807.	307.	35.	112.9
1.02	13.20	224	37.33	928.	475.	42.	113.4
1.02	13.30	225	37.50	1030.	674.	47.	113.9
1.02	13.40	226	37.67	1119.	852.	52.	114.2
1.02	13.50	227	37.83	1199.	997.	55.	114.4
1.02	14.00	228	38.00	1268.	1108.	57.	114.6
1.02	14.10	229	38.17	1330.	1198.	59.	114.7
1.02	14.20	230	38.33	1390.	1274.	61.	114.8
1.02	14.30	231	38.50	1453.	1343.	63.	114.9
1.02	14.40	232	38.67	1522.	1414.	64.	115.0
1.02	14.50	233	38.83	1593.	1487.	64.	115.1
1.02	15.00	234	39.00	1660.	1558.	67.	115.2
1.02	15.10	235	39.17	1717.	1624.	68.	115.3
1.02	15.20	236	39.33	1773.	1686.	70.	115.4

1.02	15.40	238	39.67	2134.	18/9.	115.4
1.02	15.50	239	39.83	2616.	2150.	115.9
1.02	16.00	240	40.00	3277.	2942.	116.3
1.02	16.10	241	40.17	3908.	3614.	116.5
1.02	16.20	242	40.33	4233.	4085.	116.7
1.02	16.30	243	40.50	4236.	4239.	116.7
1.02	16.40	244	40.67	3992.	4110.	116.7
1.02	16.50	245	40.83	3617.	3794.	116.6
1.02	17.00	246	41.00	3165.	3377.	116.4
1.02	17.10	247	41.17	2791.	2965.	116.3
1.02	17.20	248	41.33	2515.	2642.	116.1
1.02	17.30	249	41.50	2300.	2400.	116.1
1.02	17.40	250	41.67	2111.	2210.	116.0
1.02	17.50	251	41.83	1949.	2081.	115.9
1.02	18.00	252	42.00	1814.	1980.	115.8
1.02	18.10	253	42.17	1689.	1864.	115.6
1.02	18.20	254	42.33	1556.	1741.	115.5
1.02	18.30	255	42.50	1395.	1606.	115.3
1.02	18.40	256	42.67	1198.	1449.	115.1
1.02	18.50	257	42.83	986.	1276.	114.8
1.02	19.00	258	43.00	780.	1091.	114.5
1.02	19.10	259	43.17	600.	903.	114.3
1.02	19.20	260	43.33	450.	727.	114.0
1.02	19.30	261	43.50	340.	591.	113.7
1.02	19.40	262	43.67	258.	478.	113.4
1.02	19.50	263	43.83	197.	399.	113.2
1.02	20.00	264	44.00	149.	328.	113.0
1.02	20.10	265	44.17	114.	289.	112.8
1.02	20.20	266	44.33	89.	258.	112.7
1.02	20.30	267	44.50	71.	238.	112.5
1.02	20.40	268	44.67	57.	219.	112.3
1.02	20.50	269	44.83	47.	201.	112.1
1.02	21.00	270	45.00	40.	184.	112.0
1.02	21.10	271	45.17	34.	165.	111.8
1.02	21.20	272	45.33	30.	149.	111.7
1.02	21.30	273	45.50	27.	134.	111.5
1.02	21.40	274	45.67	25.	120.	111.4
1.02	21.50	275	45.83	23.	108.	111.3
1.02	22.00	276	46.00	22.	98.	111.2
1.02	22.10	277	46.17	21.	88.	111.1
1.02	22.20	278	46.33	20.	80.	111.0
1.02	22.30	279	46.50	20.	73.	111.0
1.02	22.40	280	46.67	20.	68.	110.9
1.02	22.50	281	46.83	20.	64.	110.9
1.02	23.00	282	47.00	20.	60.	110.8
1.02	23.10	283	47.17	20.	57.	110.8
1.02	23.20	284	47.33	20.	54.	110.7
1.02	23.30	285	47.50	20.	51.	110.7
1.02	23.40	286	47.67	20.	48.	110.6
1.02	23.50	287	47.83	20.	46.	110.6
1.03	0.00	288	48.00	20.	43.	110.6
1.03	.10	289	48.17	20.	41.	110.6
1.03	.20	290	48.33	19.	40.	110.5

PEAK OUTFLOW IS 4239. AT TIME 40.50 HOURS

CFB	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
4239.	2001.	563.	283.	82015.
120.	57.	16.	8.	2322.
	17.73	19.96	20.18	20.18
	450.37	506.96	512.66	512.66
	992.	1117.	1130.	1130.
	1224.	1378.	1393.	1393.

THOUS CU M

RUNOFF SUMMARY: AVERAGE FLOW IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES(SQUARE KILOMETERS)

	PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT					
1	4236.	2024.	566.	284.	1.05
(	119.94)(	57.31)(	16.03)(	8.05)(	2.72)
ROUTED TO					
2	4239.	2011.	563.	283.	1.05
(	120.03)(	56.67)(	15.95)(	8.01)(	2.72)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

ELEVATION
STORAGE
OUTFLOW

INITIAL VALUE
110.00
0.
0.

SPILLWAY CREST
110.00
0.
0.

TOP OF DAM
115.90
78.
2093.

RATIO
OF
PMF

0.00 116.72

MAXIMUM
DEPTH
OVER DAM

.82

MAXIMUM
STORAGE
AC-FT

92.

MAXIMUM
OUTFLOW
CFS

4239.

DURATION
OVER TOP
HOURS

2.00

TIME OF
MAX OUTFLOW
HOURS

40.50

TIME OF
FAILURE
HOURS

0.00

FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79

VERSION JULY 1978
LAST MODIFICATION 26 FEB 79

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT 1
ROUTE HYDROGRAPH TO 2
END OF NETWORK

FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79

RUN DATE: 81/05/14.
TIME: 14.44.10.

LAKE ROBERT KUDKE DAM (00262)
INFLOW HYDROGRAPHY AND ROUTING
N J DAM INSPECTION

JOB SPECIFICATION									
NO	NHR	NRIN	IOAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
290	0	10	0	0	0	0	0	4	0
		JOPER	NWT	LRUPT	TRACE				
		5	0	0	0				

MULTI-PLAN ANALYSES TO BE PERFORMED

NPLAN= 1 NRTIO= 5 LRTIO= 1

RTIO= .10 .30 .50 .70 .90

SUB-AREA RUNOFF COMPUTATION

COMPUTE HYDROGRAPH

ISTAU	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

INYD	IUNG	TAREA	SNAP	TRSDA	TRSPC	RAVIO	ISNOW	ISAME	LUCAL
1	2	1.05	0.00	1.05	.80	0.000	0	0	0

PRECIP DATA

SPEE	PHS	R6	R12	K24	R48	R72	R96
0.00	22.00	112.00	123.00	133.00	142.00	0.00	0.00

LOSS DATA

LRDPT	STKR	BLTK	RTIO	STKR	RTIO	STRTL	ENSTL	ALHXL	RTIMP
0	0.00	0.00	1.00	0.00	1.00	1.00	.15	0.00	0.00

UNIT HYDROGRAPH DATA

PEAK OUTFLOW IS 3815, AT TIME 40.20 MINUTES

FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION STATION AREA PLAN RATIO 1 RATIO 2 RATIO 3 RATIO 4 RATIO 5
RATIOS APPLIED TO FLOWS
RATIO 1 RATIO 2 RATIO 3 RATIO 4 RATIO 5

HYDROGRAPH AT 1 1.05 1 424. 1271. 2118. 2965. 3812.
(2.72) (11.99) (35.98) (59.97) (83.96) (107.95) (

ROUTED TO 2 1.05 1 287. 1189. 2005. 2968. 3815.
(2.72) (8.14) (33.66) (56.78) (84.03) (108.03) (

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 INITIAL VALUE SPILLWAY CREST TOP OF DAM
ELEVATION 110.00 110.00 115.90
STORAGE 0. 0. 78.
OUTFLOW 0. 0. 2093.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	112.84	0.00	34.	287.	0.00	41.17	0.00
.30	114.70	0.00	59.	1189.	0.00	40.67	0.00
.50	115.79	0.00	76.	2005.	0.00	40.67	0.00
.70	116.26	.36	84.	2968.	1.17	40.50	0.00
.90	116.57	.67	90.	3815.	1.67	40.50	0.00

FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79

APPENDIX 5

REFERENCES

APPENDIX 5

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